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Business Case Analysis for the versatile depot automated test station used in the USAF Warner Robins Air Logistics Center maintenance depot

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THESIS

BUSINESS CASE ANALYSIS FOR THE VERSATILE DEPOT AUTOMATED TEST STATION USED IN THE USAF WARNER ROBINS AIR LOGISTICS CENTER MAINTENANCE DEPOT

by

Scott L. Doss

June 2008

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I. INTRODUCTION

A. PURPOSE OF THIS STUDY

The purposes of this thesis to develop an Enterprise Architecture (EA) for the Warner Robins Air Logistics Center (WR- ALC) depot, look at the overall management of Automated Test Stations (ATS) in the USAF, and to perform an extended Business Case Analysis for the WR-ALCs "To-Be" ATS the Versatile Depot Automated Test Station.

The Department of Defense (DoD) is facing the huge problem of supporting many weapons systems. The ATSs the DoD uses to keep today's weapons in the fight are aging as technology passes them by. These legacy ATSs were not designed to be upgraded to meet future needs, but rather for a specific weapons system. The vast array of legacy ATSs has left us with hundreds of different (stovepipe) specialized systems that are becoming obsolete. It is estimated that DoD has over 400 different types of ATSs currently operating in the different services. These ATSs are used to diagnose problems with avionics and weapon system components. These components can be fixed at depots or at the I-level maintenance shops. Once the problem is diagnosed, the part can then be repaired, and either returned back to the original owner or put back into the supply system for future use. The average age for the AF-ATSs is 24 years. That is, many ATSs are well past their estimated operational life cycle and it is getting increasingly difficult to find repair parts. A GAO report (2003) reported that the DoD "spent over $50 billion in its acquisition and support of ATE from 1980 through 1992, and the procurement was characterized by the proliferation of testers designed to support a specific weapon system or component. These testers are quickly becoming obsolete and more difficult and costly to maintain because they may no longer be in production, and parts may not be readily available." (GAO, 2003, p. 8).

The DoD's preferred approach to solve this problem motivated the Agile Rapid Global Combat Support (ARGCS), an Advanced Concept Technology Demonstration (ACTD). The ARGCS ACTD is an approved five year effort that addresses the war fighters' problems with all ATSs and future Joint ATS requirements. This same concept of jointness and open architecture led to the development of the Warner Robins Air Logistics Center (WR-ALC) automated test system called the Versatile Depot Automated Test Station (VDATS). As it happens, the VDATS implements many of the ARGCS concepts and will be addressed in the form of a Business Case Analysis (BCA) in this thesis.

Major organizations have various IT governance processes, low level system architectures, and maybe an organizational chart to help manage everything. Most organizations fail to develop an overall EA to illuminate their structure and functions. One purpose of this thesis is to develop a high level "As-Is" EA for the WR-ALC depot to show how the organization functions with some of its various ATSs and how a "To-Be" ATS (such as VDATS) would impact the mission of that organization.

Next, management of ATSs is vital if the USAF is going to move toward true integration of systems. Our current strategy (or lack thereof) has left hundreds of stovepipe ATS that are proprietary and not interoperable. This thesis will identify the problem areas that have led to the vast array of stovepipe systems and offer a path to make the future truly interoperable with a new ATS management approach.

II. BACKGROUND

A. ADVANCED CONCEPT TECHNOLOGY DEMONSTRATION

1. INTRODUCTION

The acquisition of systems used for the Cold War worked very well and produced some of the best weapons systems in the world for those times; however, it was very expensive and took too long from concept to actual deployment. In today's times with cutbacks, technology increasing at a faster rate, and the unpredictability of our adversaries, the old acquisition system will not work. In 1994 this was realized and a new acquisition approach to get the WarFighters critical needs faster was put in place called the Advance Concept Technology Demonstration (ACTD) process. This process was designed to be an early, fast, and inexpensive way to evaluate systems with advanced technology. It also was designed such that it could be easily integrated into the formal acquisition process if it was chosen to move forward.

The concept of introducing new technologies to the WarFighter prior to the normal acquisition timeframe allowed technicians who have operational experience to evaluate the effectiveness of the new military utility. The evaluation results could then be used to better apply the technology and make appropriate adjustments so that the system being evaluated performed to the maximum or it was reviled that the system could not meet WarFighter needs. This ACTD process actually saved time and money because it was able to get systems to the field faster.

> The Joint WarFighter S&T Plan explains the following: ACTDs are designed to transfer technology rapidly from the developers to the users. They are user oriented and represent an integrated effort to assemble and demonstrate a significant, new or improved military capability that is based on mature advanced technologies. They are also on a scale large enough to demonstrate operational utility and end-to-end system integrity. A demonstration is jointly developed and implemented by the operational user and materiel development communities as key participants. ACTDs allow the WarFighter to:

- Evaluate a technology's military utility before committing to a major acquisition effort.

- Develop concepts of operation for employing the new technology.
- Retain a low-cost residual operational capability if the commander desires.

There are three main areas of focus for ACTDs which are 1) users needs, 2) exploit mature technologies, and 3) potential effectiveness. The user's needs are the main reason for the implementations of ACTDs. The ACTDs are developed to get users needed technology to the field faster than the formal acquisition process by focusing on those needs. In order to analyze requirements against proposed solutions then heavy user participation is needed for evaluation. The ACTD places mature technology in the work force to conduct numerous intense evaluations to gain knowledge and experience on that system. This process provides the users an evaluation method to make adjustments for operational requirements, thus meeting their needs. By moving forward in this matter it allows measures to be taken to ensure that all needed capability has been ultimately met. One key feature of the ACTD is to exploit mature technologies. Doing this lessens risks in the acquisition process and saves money. Finally, the ACTD results must be evaluated for military effectiveness. After evaluation, the ACTD will end in one of the following three ways.

- Give the system directly to the WarFighter for execution.
- Enter the formal acquisition process and an advanced milestone.
- Terminate all efforts on the system or change them based on the results from the ACTD.

In conclusion, the ACTD is a way of assisting the DOD's formal acquisition process in order to meet critical requirements fast and effective with minimum risk of funds. A more in depth discussion of ACTDs and the JACTD by Kratzer can be found in Appendix A.

B. AUTOMATED TEST SYSTEMS AND AGILE GLOBAL COMBAT SUPPORT (ARGCS)

1. INTRODUCTION

The US military has gone from each service operating autonomously to a focus on net centricity with jointness. Wordweb online defines "joint" to be " the shape or manner in which things come together;" if you apply this to the military then one could derive the term jointness to mean how each branch of service in the DoD operates together, so the term jointness implies that future operations will be done together. In fact, the Joint Pub1-02 defines joint as "Connotes activities, operations, organizations, etc., in which elements of two or more Military Department participate." In the past operations have been independent and the budget of the military has been very large. With today's cut backs and the do more with less attitude, the DoD must find better ways to develop systems and operate more efficiently.

In today's world of ever changing demands, logistics footprint, spares, manpower issues, duplication of system functionality, and interoperability are all problems areas that must be addressed. All of these affect our operations and ATSs. The war on terror has put high demands on the WarFighter which require joint activities world wide. Moving all of the support personnel and equipment is a tremendous effort that requires intense logistics. The logistics footprint the joint WarFighter contains a large repertoire of legacy systems, as is the cost of keeping spares on hand. This can entail having large (and expensive) inventories of parts and testers. Next come manpower issues. Legacy systems personnel must be trained on multiple systems. There is also duplication of system functionality among the legacy testers which has led to interoperability issues.

In the past, one branch of service would deploy alone with its weapon system, support equipment, and personnel; however, today's mission requires joint activities which puts different requirements on the WarFighter. In a joint environment sheer size of the support tail can be overwhelming in terms of troop movement, logistics, and cost. For joint operations, we deploy support equipment and personnel for each service and are left with support equipment for each independent system (duplication of systems). It is this duplication of stovepipe systems that is currently giving the DoD interoperability and integrations issues. The reason there are so many legacy stovepipes is that each System Program Office acquires an ATS each time it adds a new capability for the WarFighter. In the past, having all of these ATS was not a major issue. But this mode of operation is poorly suited to staying abreast of technology, and reducing cost. Finally, the most important issue is that of interoperability. There is a specific ATS for each piece of equipment and they do not interoperate, nor do legacy testers operate in a joint environment. The DoD found that there was a huge ATS problem for the services.

After further investigation it found the following from the Agile Rapid Global Combat Support (ARGCS) Joint CONOPS (2006):

> Problem 1: Lack of interoperability between Services' support equipment
>
> Lack of interoperability between Services' support equipment prohibits integrated weapon system support necessary in today's Joint Operational Environment. This includes limited interoperability between each Service's Organizational, Intermediate and Depot maintenance levels.
>
> Problem 2: Support Equipment Not Available for Newly Fielded Weapon Systems
>
> War fighting capabilities are being fielded faster than the required support equipment can be fielded. Support equipment sometimes lags introduction of weapon systems by several years.
>
> Problem 3: Closed System Limits Support Equipment Upgrades or Enhancements
>
> The performance of today's weapon systems is quickly surpassing the technical capability of existing Combat Support Systems (CSS). Much of today's CSS physically cannot be upgraded to meet tomorrow's weapon system performance requirements.
>
> Problem 4: High Support Costs
>
> Support costs are rising significantly as the hundreds of ageing DOD CSS (mostly designed in the '70s and '80s) become obsolete. Advances in technology and the obsolescence of older equipment are driving many CSS toward major product improvements to continue supporting legacy weapon systems and implementing new test and diagnostic capability required by new weapon system designs.

> Problem 5: Huge Logistic Footprints
>
> Proliferation of test system types and continued use of old technology drives huge logistic footprints (both weight and volume) which lengthens time to deploy and inflates required resources (spares, personnel, facilities and transportation).
>
> Problem 6: High False Failure Rates
>
> Existing combat support systems have high false failure rates (known by various terms such as CNV, NEOF, RTOK, and A799), which lead to unnecessarily high requirements for weapon system spares and overburdened manpower through unnecessary maintenance actions. (ARGCS Joint CONOPS, 2006, p. 1)

The DoD identified all of these problems with ATSs and decided in 1994 that DoD policy on ATSs would encourage reducing the number of unique testers and moving toward a Family of Automated Test System (FATS). It is the FATS concept that has led to a five year approved ACTD called ARGCS which attempts to solve the short falls of ATSs in a joint environment.

The ARGCS mission is defined by the Joint Concept of Operations (2006) “to provide a modular tester solution capability that is scalable, interoperable, common, and will facilitate fault isolation and repair of electronic components of major weapons systems.” (ARGCS Joint CONOPS, 2006, p. 5) The ARGCS ACTD is a promising approach toward fixing today’s problems in the DoD, and testing high tech concepts for military utility at modest cost. The ARGCS concept calls for future systems to be built with jointness in mind. This means new ATSs to test all types of equipment. (For example, the avionics box from the AF F-15 could hook up to the new tester and run its test. Next, the navy would hook up the F-18s avionics to the same tester and run its required test. This concept would provide true joint interoperability of ATSs.)

The ARGCS system must also show that it is able coordinate and distribute maintenance records, document all fix actions, and make sure that all documentation is accessible in theater and out of theater of operations. Better documentation control will save time and money.

ARGCS is an open architecture concept that will be used with future joint service combat support systems. The ARGCS ATS system will not use proprietary tools and be opened ended systems. Commercial Off the Shelf Technology (COTS) will allow vendors to apply fixes and develop new ATS test program sets quickly. The ARGCS ACTD demonstrates this proof of concept.

The ARGCS system will be evaluated against Critical Operational Issues (COI) taken from the ARGCS Joint CONOPS (2006) that are listed below:

1. Does the ARGCS system provide the required compatibility between services support equipment, and interoperability necessary to exchange maintenance data between maintenance levels?

2. Does ARGCS accommodate support equipment availability required to maintain newly fielded weapon systems?

3. Can ARGCS be rapidly upgraded to support weapon system performance requirements?

4. Does ARGCS system reduce operation and support costs?

5. Does ARGCS reduce the logistic footprints (spares, size, and personnel)?

6. Does ARGCS reduce high false failure rates?

7. Is the ARGCS system usable and suitable for the WarFighter in its intended operational environment?

It is also important to show some of the Key Performance Parameters (KPP) from the ARGCS Joint CONOPS (2006) in Figure 1 below.

JWP-CAPABILITY MATRIX				
JWP	**COI**	**Key Technology**	**Operational Requirement**	**Brief Test Scenarios**
(1) Support System Interoperability Lack of interoperability between Services' support equipment (and limited interoperability between each Service's Organizational, Intermediate and Depot maintenance levels) prohibits integrated weapon system support necessary in today's Joint Operational Environment	**1, 7**	**(1)** Open System Architecture: **(a).** Multiple Run Time Environment (MRTE) **(b).** Common Test Interface (CTI) **(c).** Bus Emulation (BE) **(d).** Local Area Network Extensions For Instrumentation (LXI) **(e).** Synthetic Instrumentation (SI) **(f).** Digital & Analog Instrumentation (DAI) **(g).** Automatic Test Mark-Up Language (ATML)	**1.1** Warfighter shall be able to use System to support multiple weapon systems to include cross-service. **[CONOPS 3.3.1(1)]**	**1.1.1** Navy's ATS1 (ARGCS System) will host the Marines LAV weapon system. Navy Warfighters shall perform diagnostic testing on the LAV weapon system using the ATS1 System. **1.1.2** Navy's ATS1 will host multiple weapon systems (F/18?). Navy Warfighters shall perform diagnostic testing on the F/18 and ? Weapon systems using the ATS1 System.

Figure 1. KPP for the ARGCS System

The ARGCS ATS will be a combination of COTS of integrated diagnostics and embedded diagnostics technologies that test digital, analog, and radio frequency avionics equipment for the WarFighter. The main key to this technology enabling interoperability will be a Common Test Interface (CTI). The CTI will be the interface between the new ARGCS system and the numerous legacy and newly acquired systems. The legacy systems Test Program Sets (TPS) (software that actually executes the avionics test) can run on the new ATS thus creating the common ATS framework. The system will also enable numerous new functional capabilities that will help improve the failure rate diagnosis, execution time, false pulls rates, and overall maintenance operations. According to the ARGCS Joint CONOPS (2006) the ARGCS system will address the following operational requirements.

1. Interoperability: Open Architecture capacity

    a. Must be reconfigurable to support different systems

    b. Support multiple types of tests

c. Host legacy Test Program Sets

d. Use a CTI for legacy and joint systems

2. Net-Centric: potential for sharing

a. Allow data to be accesses via the internet

b. Provide analysis of trouble issues

c. Ensure the most updated systems fix actions are available

d. Interface in joint environment

3. Reduction of logistics footprint

a. Smaller systems

b. Limited spares

c. Low maintenance

4. Speed & precision of fault diagnosis and repair ability

a. Quick turn time on fix actions

b. Fast fault diagnosis

c. Low false pulls

d. Data sharing access

5. Use of synthetic instrumentation

a. Use latest COTS synthetic instrumentation

b. Common open architecture

c. Upgradeable (ARGCS Joint CONOPS, 2006, p.10)

As a result of the initiation of the ARGCS ACTD in 2002, with Northup Grumman and Boeing as contractors, it has been shown that the ARGCS concept requirements can be met. Even though ARGCS is still an ACTD, the AF is currently pursuing an open architecture ARGCS concept tester that is named the Versatile Depot Test Station (VDATS). The VDATS is a future ATS that has the functionally to replace the legacy tester at a ratio of one VDATS to two legacy testers. The VDATS idea came from the 742nd Combat Sustainment Group Depot at Robins AFB and will be explained below.

C. WARNER ROBINS AIR LOGISTICS CENTER DEPOT

1. INTRODUCTION

The Warner Robins Air Logistics Center (WR-ALC) Depot is the main avionics shop for the USAF. It is one of the biggest maintenance facilities that the USAF has in its inventory and houses hundreds of Automated Test Systems (ATS). The background and mission is explained below from the 402 EMXG/MXVOPE and WR-ALC/FMC Economic Analysis (2005).

> WR-ALC is the Avionics Center for the Air Force and was designated the Electrical Components, ATS, Radars, and Airborne Electronics Technology Repair Center (TRC). The incredible pace of Technology changes presents a continuing challenge to replace obsolete and out-of-production components in the TRC in order to support the many systems fielded twenty years ago. It is also necessary to keep our workforce trained and equip our repair systems so that they can accommodate the new, ever-changing technology. (402 EMXG/MXVOPE and WR-ALC/FMC Economic Analysis, 2005, p.1)"

The WR-ALC performs test on both common and unique avionics for more than 260 weapon systems and numerous components. They work on many Shop Replaceable Units and Line Replaceable Units from all of the various electrical components. The technology they work on ranges from the 1960's through the 2005's and continuously requires a vast array of equipment and components. The average age for their testers is 24-25 years old with the oldest being purchased in the 1960s. The skill set and parts required to maintain these components is getting harder to find with technology being outdated and often requires reverse engineering to perform fix actions. The electrical blueprint on approximately 120 of these testers is currently outdated, which makes them difficulty to sustain thus again requiring reverse engineering. The depot is not always able to meet its mission requirements because when one tester goes down the parts are just too hard to find and in some cases they must be custom made.

In order to mitigate problems affecting the depot and outdated testers the depot decided to design a tester that would meet its badly needed total requirements. The tester that the depot came up with was the Versatile Automated Test Station (VDATS). The VDATS is an open architecture commercial off the shelf technology tester that will replace legacy testers at a ratio of one VDATS per two or more legacy testers. VDATS is currently under development and in meeting the ARCGS concept requirements.

D. ENTERPRISE ARCHITECTURE

1. INTRODUCTION

Modern organizations have become extraordinarily complex and very hard to manage. So leaders have looked for new ways to manage. One of the best current methods to manage complex development is the use of the Enterprise Architecture (EA). The term enterprise is defined by Webster's as "an organization created for business ventures." And the Department of Defense Integrated Architecture Panel (1995) defines architecture as "the structure of components, their relationships, and the principles and guidelines governing their design and evolution over time." By looking at these two definitions we can conclude that an EA would be the structure of a business and the interactions of its components. Current industry uses EA methodology as a management tool and has shown excellent returns. It is because of the benefits seen in industry that the DoD has now mandated the use of EA.

The National Defense Authorization Act of FY 2005 prescribes the establishment of Investment Review under the Office of the Secretary of Defense (OSD) and requires the Defense Business Systems Management Committee (DBSMC) to develop a Business Enterprise Architecture (BEA) to guide and constrain DoD business system investments and a transition plan to implement the architecture.

The BEA is an Enterprise-level architecture that reflects corporate DoD priorities and requirements for business systems, and provides a common framework to ensure that key information is available to DoD decision-makers Department-wide. The BEA is developed and maintained by the Business Transformation Agency (BTA), which reports to the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD (AT&L)), and serves the interests of the entire Business Mission Area (BMA) of the DoD.

The BEA also contains a set of integrated Department of Defense Architecture Framework (DoDAF) operations, systems, and technical standard views, which depict specific, high priority Business Enterprise Priorities (BEPs) that align to strategic transformational capabilities identified by the business enterprise leadership. The BEA is a critical component of the Investment Review Board (IRB) process and is to be used at each level of investment review to assess whether business investments going through the certification process support DoD Enterprise priorities and requirements. Summary results of these investment reviews are reported annually to Congress.

DoD Architecture Framework (DoDAF) version 1.5 (2007) explains architecture in the DoD by saying:

> Architectures within the Department of Defense (DoD) are created for a number of reasons. From a compliance perspective, the DoD is compelled by law and policy (i.e., Clinger-Cohen Act, Office of Management and Budget (OMB) Circular A-130) to develop architectures. From a practical perspective, experience has demonstrated that the management of large organizations employing sophisticated systems and technologies in pursuit of joint missions demands a structured, repeatable method for evaluating investments and investment alternatives, implementing organizational change, creating new systems, and deploying new technologies. Towards this end, the DoD Architecture Framework (DoDAF) was established as a guide for the development of architectures.
>
> The DoDAF provides the guidance and rules for developing, representing, and understanding architectures based on a common denominator across DoD, Joint, and multinational boundaries. It provides external stakeholders with insight into how the DoD develops architectures. The DoDAF ensures that architecture descriptions can be compared and related across programs, mission areas, and ultimately, the enterprise, thus, establishing the foundation for analyses that supports decision-making processes throughout the DoD. (DoDAF, 2007, p. XIV)

The importance of architecture is vitally necessary for a system to meet the joint DoD requirements. The architecture provides a foundation for DoD to create one common framework. The common framework also functions as a management for missions, system interfaces, technical guidelines, technology constraints, and activities that systems perform. Finally, it provides data in the form of views and in the words of Patrick Davidson “In God We Trust, but everyone else must have data.”

III. WARNER ROBINS-AIR LOGISTIC CENTER ENTERPRISE ARCHITECTURE

A. INTRODUCTION

The DoD currently has a major problem with supporting multiple weapons systems in all domains. The ATSs the DoD currently uses to keep today's weapons in the fight are aging and obsolescent. These legacy ATSs were not designed to be upgraded to meet future capabilities but rather for the specific weapons system at hand. In all, the vast array of legacy ATSs has left the DoD with hundreds of stovepipe systems that technological progress has left behind. It is estimated that the DoD has over 400 different types of ATSs in use through the different services. The DoD is currently trying to move toward a common ATS through initiative such as the ARGCS ACTD. The AF depot system is trying follow through implementation of an ARGCS concept system called the Versatile Automated Test Station (VDATS).

The following Enterprise Architecture (EA) is the architecture for Warner Robins-Air Logistics Center (WR-ALC) Depot. This EA, among other things, is intended to reveal any duplicative functionality among AF depot legacy ATSs, how the VDATS fits into the ARGCS picture, if there are organizational flaws in the way that the AF currently manages its ATSs, and flaws in the current ATS Procurement Process. The EA that follows was developed using the Department of Defense Architecture Framework (DoDAF) guidance and consist of the following views: OV-1, OV-2, OV-3, SV-1, SV-5, OV-5, SV-8, SV-9, TV-1, TV-2, OV-4.

B. PRESENTATION OF WR-ALC & VDATS EA IN A BUSINESS VALUE ADDED FORM

The depot at Warner Robins has two hundred and sixty different ATS's representing one hundred and fifty different configurations. The average ATS age at Warner Robins is twenty four years. The VDATS was designed to replace the legacy testers and is currently targeted to replace one hundred legacy ATS units with fifty

VDATS (with an associated footprint, power, and training reduction). Each legacy ATS is designed to test one specific piece of equipment.

One point to be noted is that EA shows how the various systems support the over all mission of the organization. It also shows how the systems touch the various components that the organizations must deal with to enable the completion of the mission. It is very crucial in EA to be able to view a complete enterprise if the EA is to be an effective tool for decision making.

The OV-1 below in Figure 2 is an "As-Is" High Level Operational Concept View which displays the mission of the WR-ALC. The OV-1 shows three AF aircraft on the bottom left having their avionics repaired by three different ATSs thus allowing them to fly and put bombs on target. The main take away from the OV-1 is that there are three different ATSs hooked up to the three different aircraft, one for each plane. Remember that the depot has over two hundred and sixty different ATSs which have led to a logistics footprint over sixteen acres of climate controlled buildings.

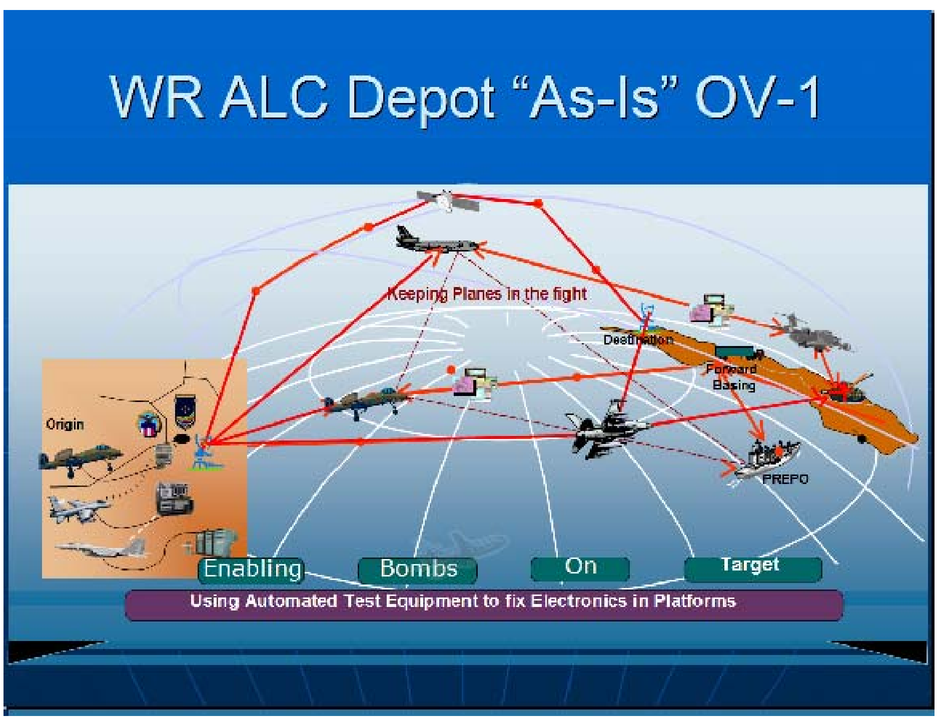

Figure 2. The As-Is High level Operational Concept View (OV-1)

The ARGCS concept is represented below in Figure 3 by using the WR-ALC Depot "To-Be" OV-1. There are the three aircraft depicted on the bottom left as before in the legacy OV-1; however, there is now only one ATS, the VDATS that can take over the functionality of hundreds of different types of legacy ATSs. This leads to a reduction in footprint, power, training, and duplication of systems. This is a huge breakthrough in the ATS environment which implements DoD policy, requires a new way of thinking, and a new approach for developing test equipment.

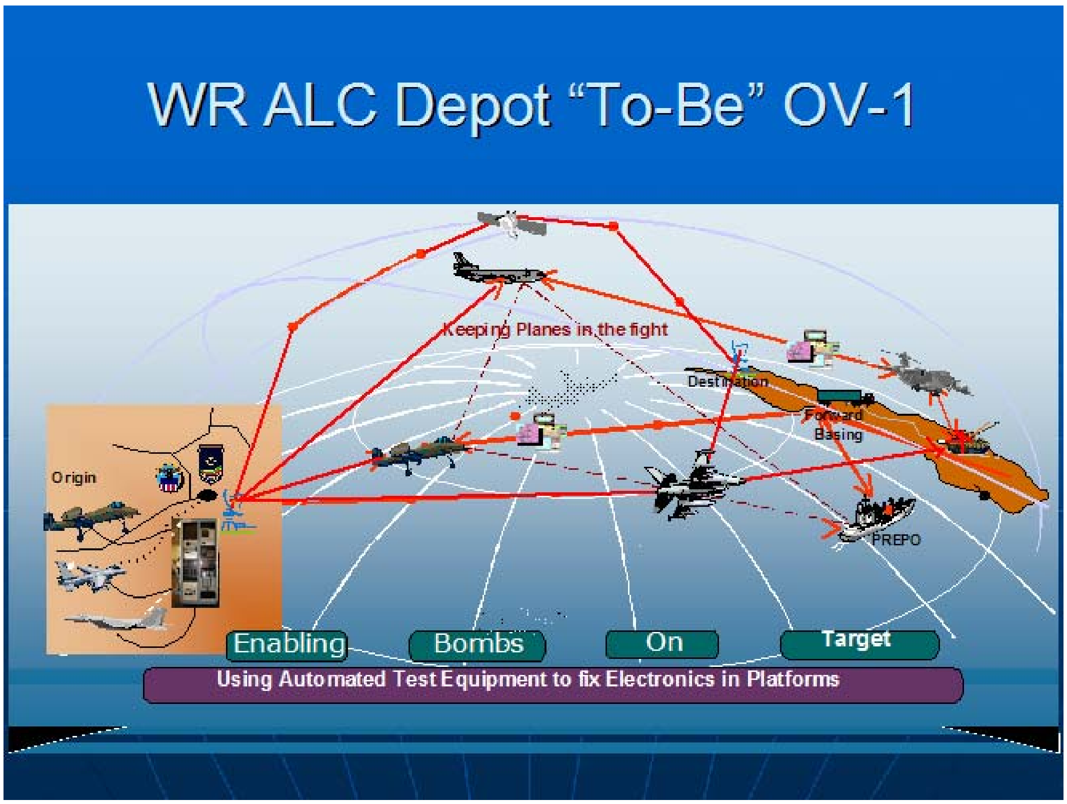

Figure 3. WR-ALC Depot To-BE OV-1

In order to look at the organizational interfaces of the depot we will look at the Operational Node Connectivity Description (OV-2), here in figure 4 below. The OV-2 shows a subset of the various organizations that the depot works with operationally. The organizations that the depot interfaces with are listed in the form of operational nodes with informational need lines attached. The representation that the OV-2 gives is very important in order to display a complete organizational operating picture. These nodes are also used in other various EA views to form a truly integrated architecture. By keeping views related it allows for the full enterprise to be represented and then ultimately managed. (A good example would be to trace the VDATS from a Systems View back up to the OV-2 to see what external organizations that the VDATS would impact.)

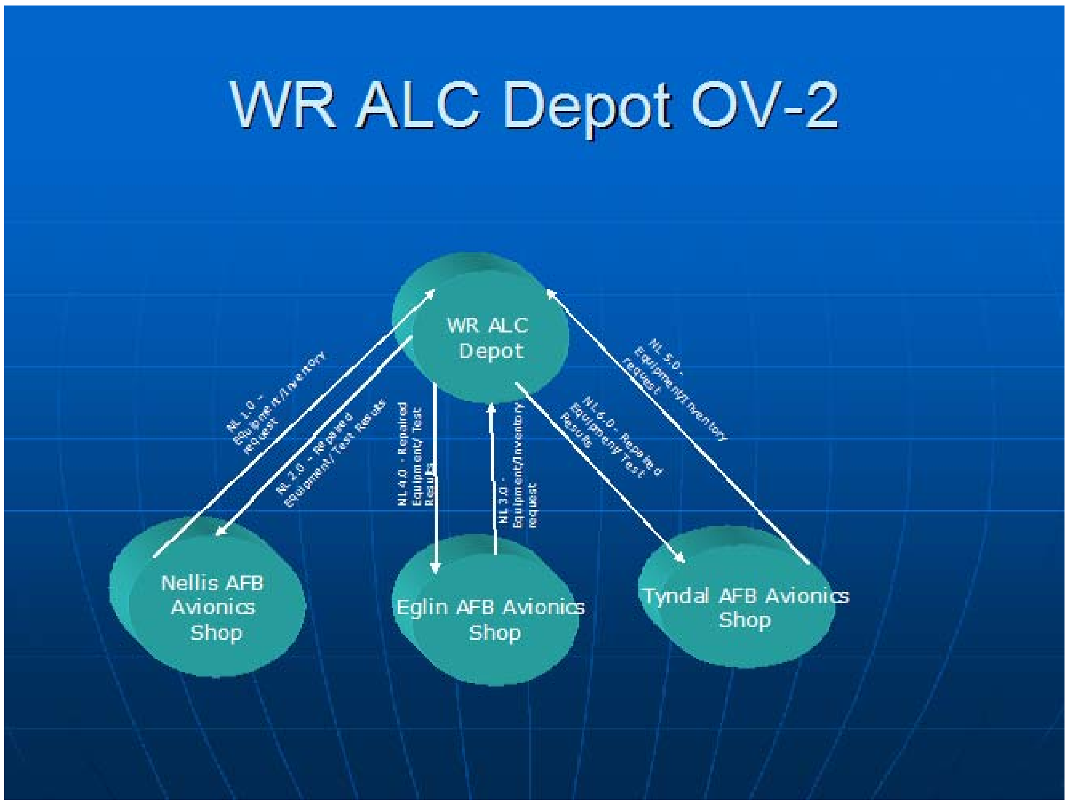

Figure 4. WR-ALC Depot Operational Node Connectivity Description (OV-2)

The OV-2, also, shows need lines from the depot to other operational nodes. These need lines represent that a need for the depot to communicate to these nodes. Now the Operational Information Exchange Matrix (OV-3) below in Figure 5 shows the internal information of the need lines and what nodes and activities in the depot use that information. (This data could be used to make decisions on the impacts of a new system or removing a legacy system from inventory.)

WR ALC Depot OV-3

Identifier	Need Line Identifier	Producing Node	Producing Activity	Receiving Node	Receiving Activity	Frequency	Timeliness
NL1.0	Equipment/Inventory Request	Nellis AFB Avionics Shop	A3	WR ALC Depot	A0	Problem Occurs	12hrs
NL2.0	Repaired Equipment/Test Results	WR ALC Depot	A0	Nellis AFB Avionics Shop	A3	Problem Occurs	12hrs
NL3.0	Equipment/Inventory Request	Eglin AFB Avionics Shop	A2	WR ALC Depot	A0	Problem Occurs	12hrs
NL4.0	Repaired Equipment/Test Results	WR ALC Depot	A0	Eglin AFB Avionics Shop	A2	Problem Occurs	12hrs
NL5.0	Equipment/Inventory Request	Tyndal AFB Avionics Shop	A1	WR ALC Depot	A0	Problem Occurs	12hrs
NL6.0	Repaired Equipment/Test Results	WR ALC Depot	A0	Tyndal AFB Avionics Shop	A1	Problem Occurs	12hrs

Figure 5. WR-ALC Depot Operational Information Exchange Matrix (OV-3)

The OV-3 above displays the need line identifier number, the producing node/receiving node from the OV-2 and the producing activity/receiving activity from the OV-5 as well as the frequency/timeliness that information is needed. This type of information is critically needed in order to really see how a new system can impact an organization.

Next, we have the As-Is Systems Interface Description (SV-1) in Figure 6 which displays an example of six different digital and analog depot ATSs that support five different types of equipment.

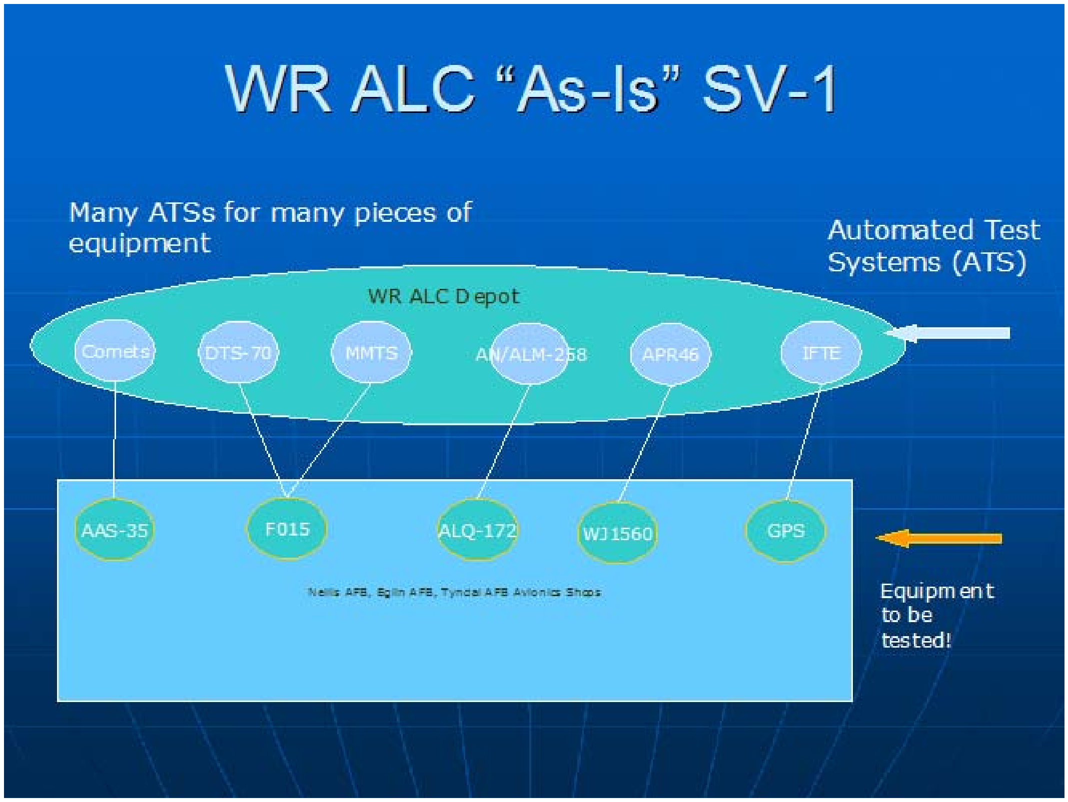

Figure 6. As-Is Systems Interface Description (SV-1)

As the SV-1 depicts, there is the duplication of functionality between these ATSs and that is a problem for logistics, sustainability, training, and many other reasons. The depot to trying to mitigate the issues mentioned thus far by following DoD policy and moving toward the ARGCS concept.

The ARGCS implementation concept can be seen below in Figure 7 in the VDATS context. Here in the WR ALC "To-Be" SV-1 the VDATS operational connections to the various pieces of equipment show how one system (VDATS) takes on the functionality of several legacy systems. This SV-1 shows the general connectivity between the system nodes and also that there are some needed interfaces between them in the form of need lines. One ATS is depicted connected up to multiple pieces of legacy equipment thus reducing duplication among ATSs and the logistics footprint where as in the legacy SV-1 each pieces of equipment had its own ATS.

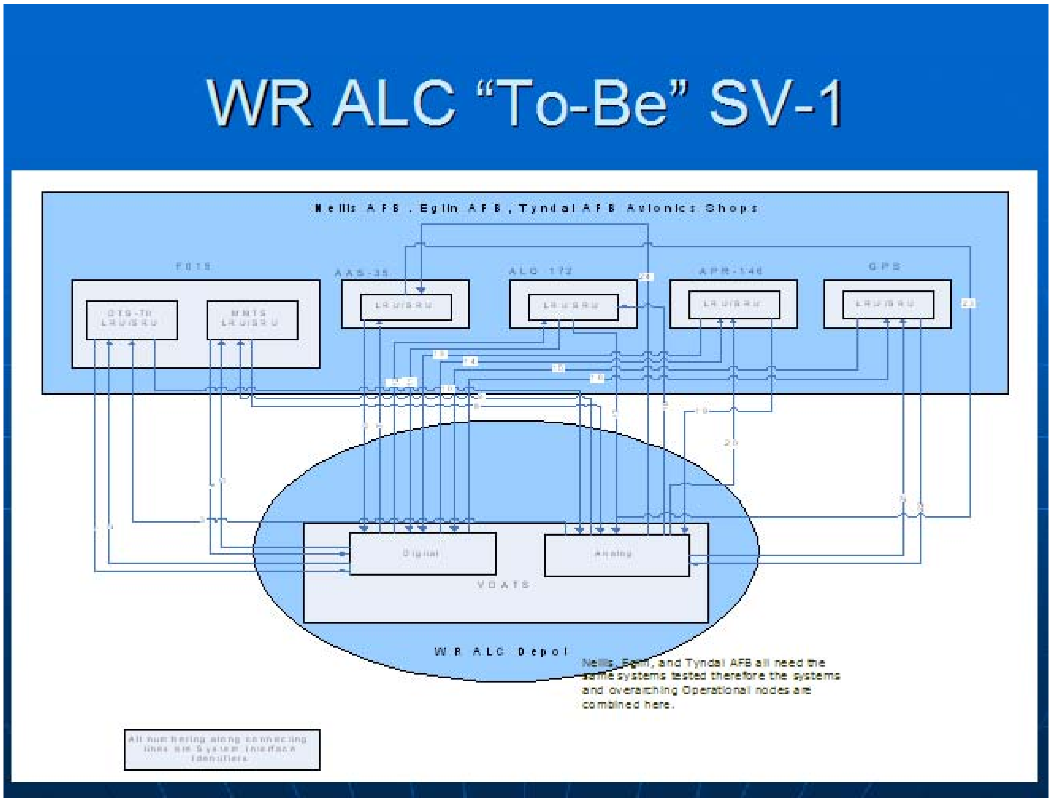

Figure 7. WR-ALC “To-Be” SV-1 for VDATS

The SV-1 in Figure 7 also shows the intra-nodal connections between the various Line Replacement Units (LRU), the Shop Replaceable Units (SRU) with their respective need lines, the VDATS digital, and analog tester’s subsystems. The need lines show that there is information being passed between the intra-nodal subsystems and is defined as test signal analog, test signal digital, test response digital, and test response analog. This SV-1 is a great visual representation of how the VDATS is one system with a family of subsystems vice the “As-Is” SV-1 mentioned earlier. The VDATS implements the ARGCS concept which is the goal of the DoD policy.

One of the main purposes of this architecture was to show that there is duplication among different ATS in the depot and Figure 8 below shows this. The SV-5 in Figure 8 below is the Operational Activity to System Function Traceability Matrix. It shows the equipment to be tested across the top and the ATS that is doing the testing along the side. By looking at the chart you can see that each piece of equipment that has to be tested has an associated digital/analog legacy tester with it. These are the legacy stovepipes that are holding the AF back and consuming so much time and money. Next, as displayed at the very bottom of Figure 8, VDATS can perform all of the tests that the legacy systems can thus eliminating the duplication. This thesis shows a sample of testers that could be replaced and that is all that was required for a conclusion to be reached.

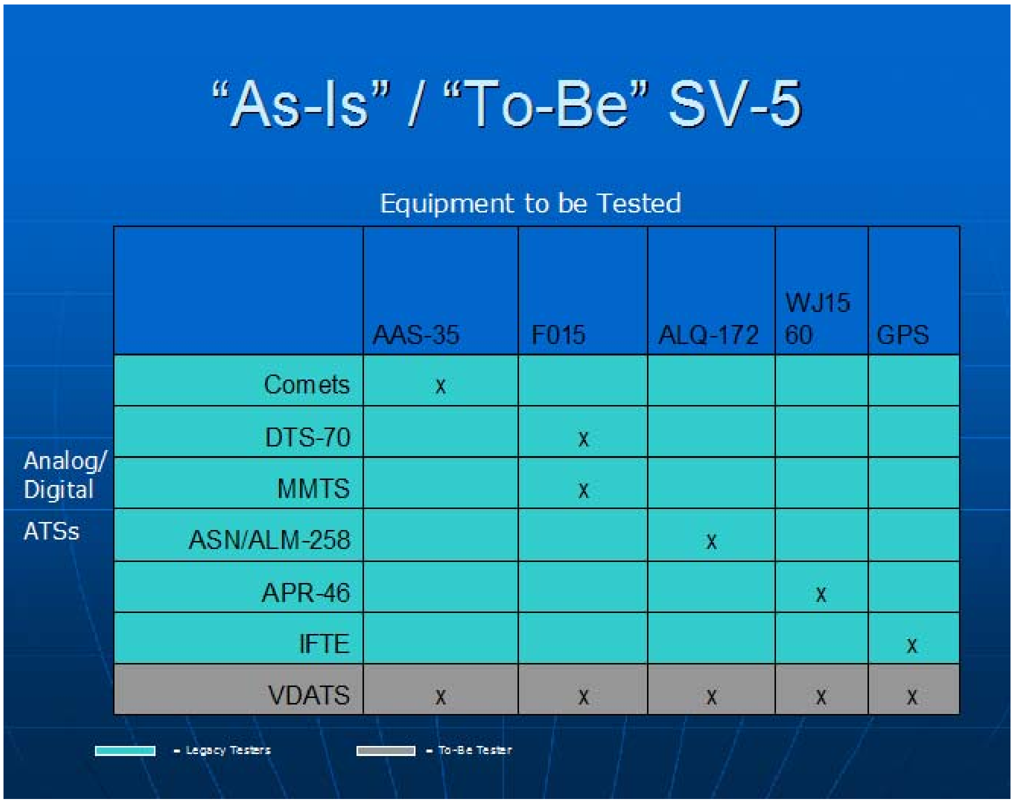

Figure 8. As-Is and To-Be Comparison (SV-5)

With hundreds of different types of ATS, there are hundreds of different types of activities that must be done in order to test equipment. Moving to an ARGCS concept allows maintainers to only learn a limited number of activities in order to perform the various tests because they are using a common tester. This approach is one of the first AF approaches to business process standardization and integration for future ATSs. The VDATS could be used as an example to create a standard process for running ATSs.

By looking at the WR-ALC Depot Operational Activity Model OV-5 below in Figure 9, using the IDEF0 format, you can see the activity “A0 - VDATS Performing Test” has the following:

1. Input of an untested aircraft avionics.
2. Constraints in the form of Operating Instructions and Standards.
3. Mechanism in the form of test equipment and test personnel
4. The outputs of tested equipment and test reports

This level 1 standard process if followed for all future avionics testing and will lead to the long term strategy of ARGCS concept implementation, thus eliminating future stovepipes.

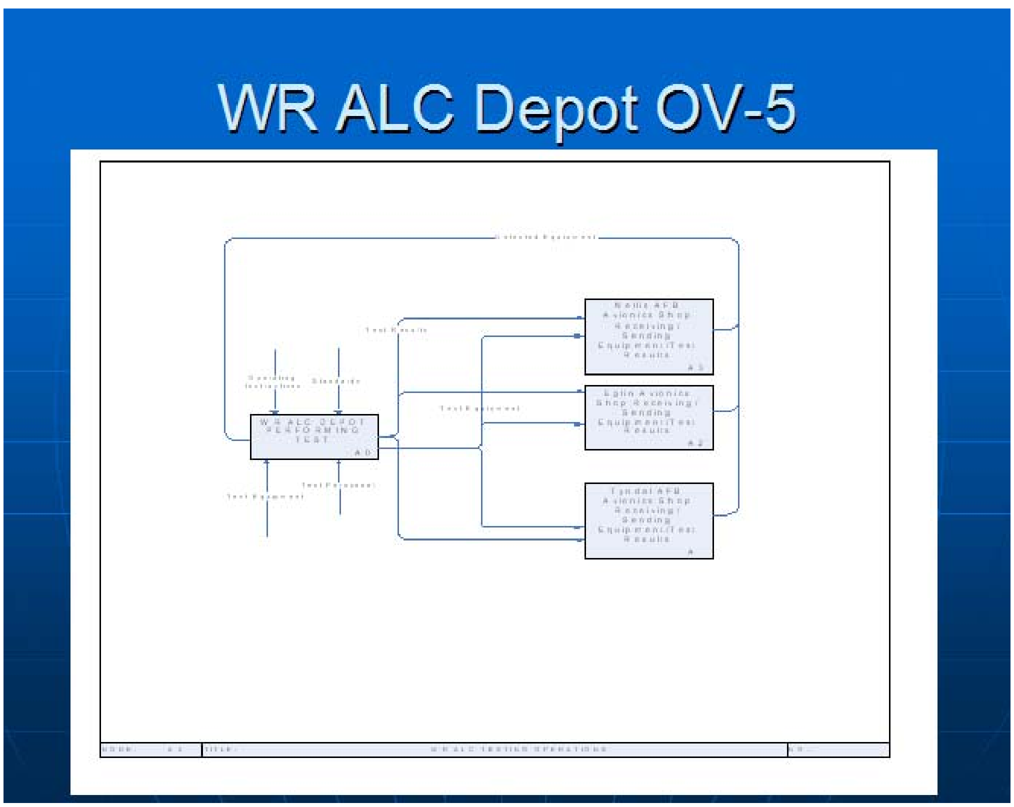

Figure 9. WR-ALC Depot Operational Activity Model (OV-5)

Decomposing the OV-5 down a level produces Figure 10 below, the "A0 Depot Testing Steps." This level 2 activity diagram represents the sub activities that are performed inside the parent activity the A0. All avionics could use this same process of being tested through their lifecycle. The only difference is that each different piece of avionics may have different operating instructions and standards. The main idea here is to standardize processes and integration of systems.

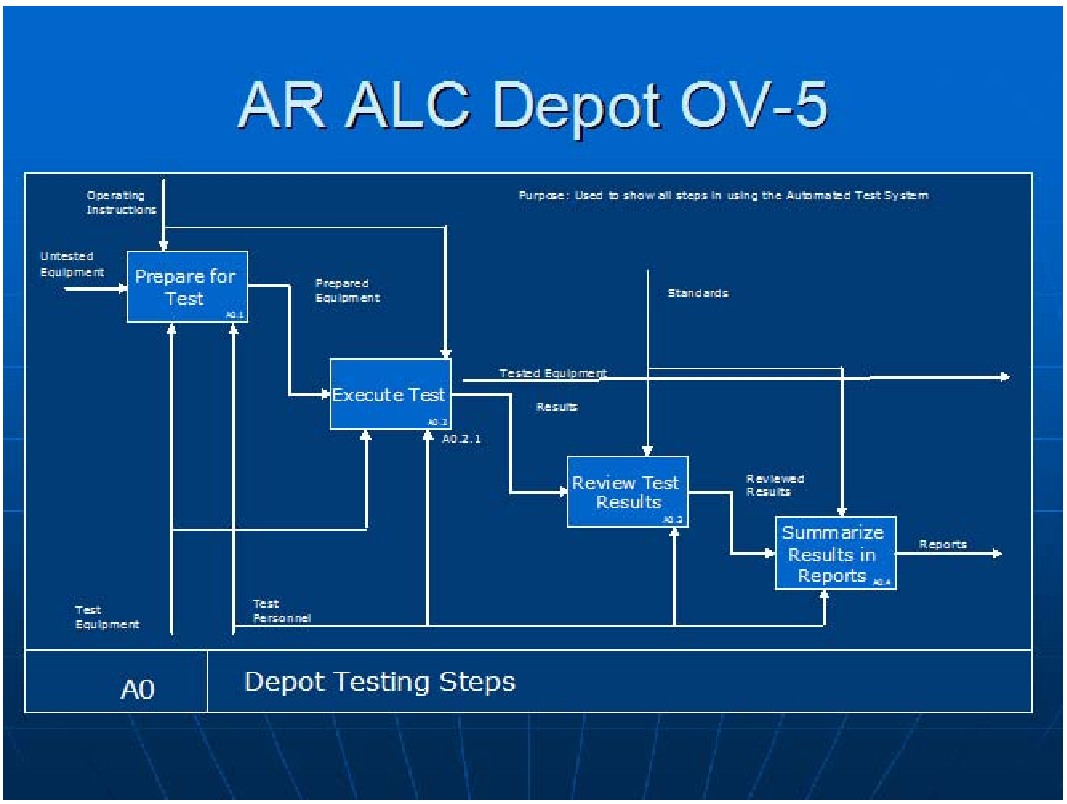

Figure 10. A0 Depot Testing Steps (OV-5)

Now let's look at the way the OV-5 relates to the OV-2. This is done in the Level 3 decomposition listed in Figure 11 below where VDATS is shown actually performing the Digital/Analog test on the AAS-35 equipment, and then those results are released back up to higher activities ultimately ending up back in the hands of an external organization in the OV-2. The input could be any piece of equipment which VDATS has had the Test Program Set (TPS) offloaded.

VDATS is scheduled to replace 100 different TPSs, with associated savings. With the VDATS having an open architecture and plug and play concept, all the operator would have to do is just load the TPS on another in house VDATS and start testing, this is true interoperability, standardization, and flexibility should one VDATS unit go out of service.

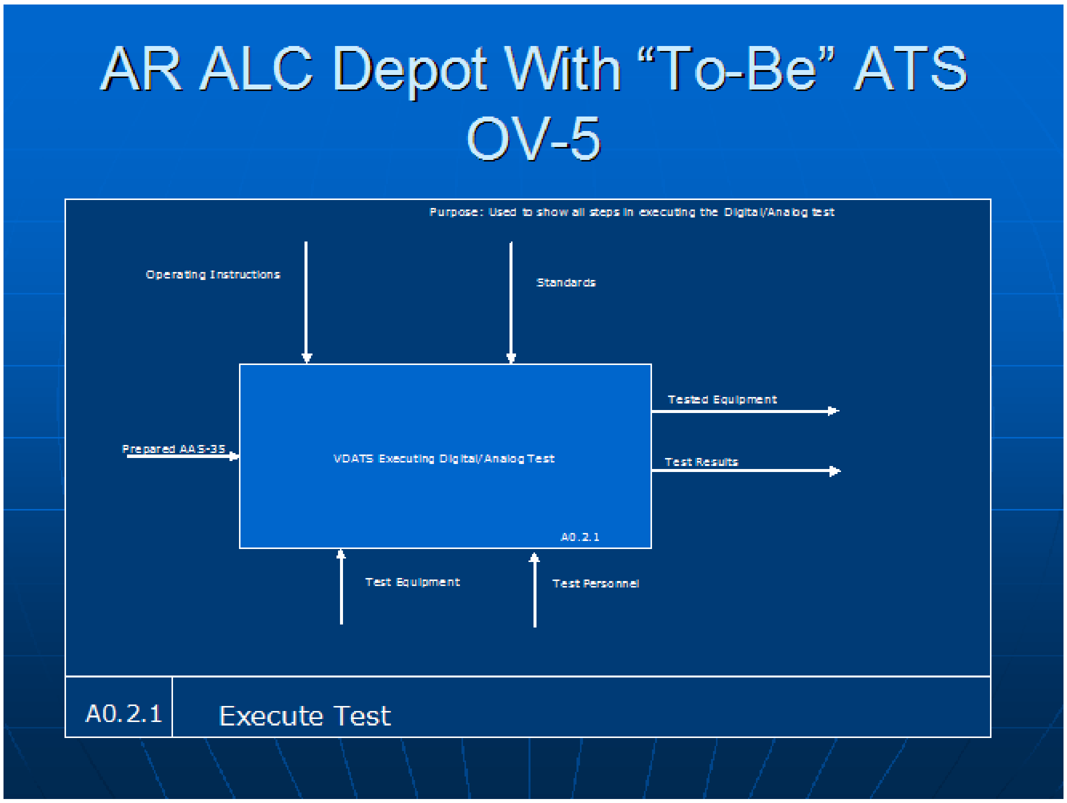

Figure 11. AO.2.1 Execute Test (OV-5)

The family of DoDAF products allows users to manage their complete business and the way it changes from time to time. One key thing that the VDATS Program Office needs to do is keep up with when they expect VDATS to take over the legacy system functionality. This can be accomplished by using the System Evolution Description (SV-8). The VDATS SV-8 is below in Figure 12.

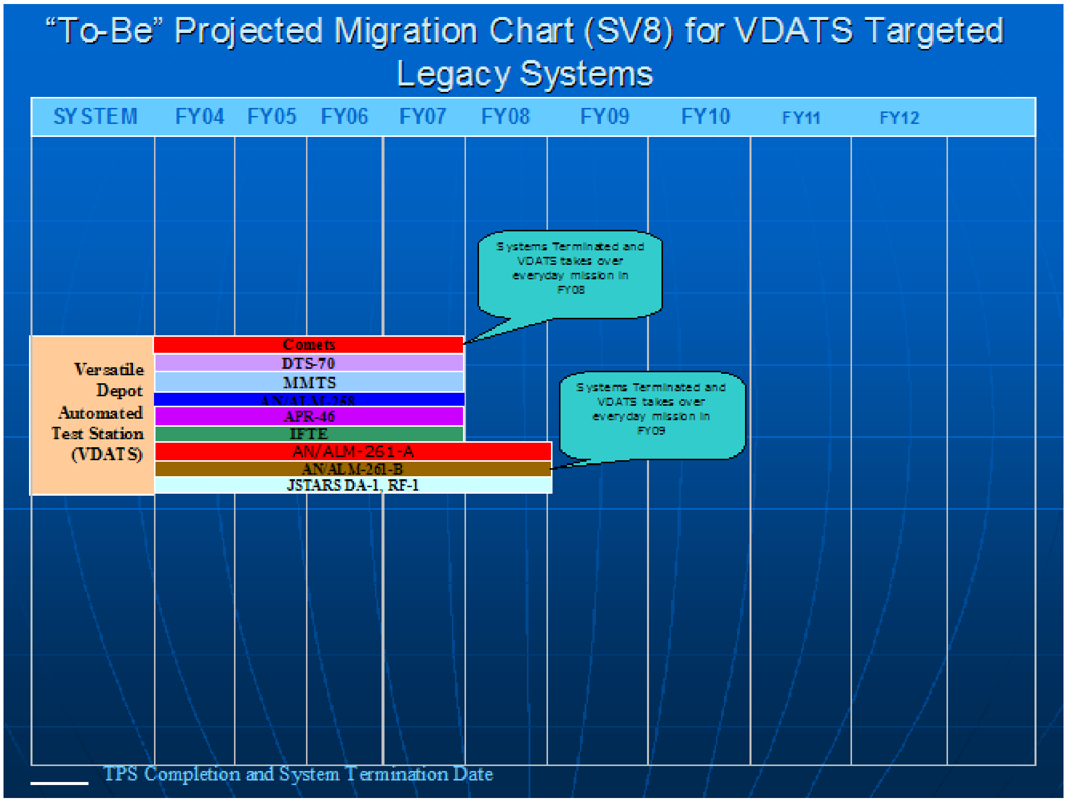

Figure 12. WR-ALC System Evolution Description (SV-8)

The SV-8 here shows transition dates for the new VDATS to subsume the legacy functionality. By using the SV-8, portfolio managers can see when legacy systems will be shut down so they can reallocate those funds else where. The use of EA in this manner truly covers all aspects of an enterprise and allows good decision making.

Most program offices forget to consider how technology will impact their legacy systems, standards they currently operate on, and the future standards that are coming. This lack of thinking has put the DoD where it is today with all of the outdated legacy systems. The DoDAF provides the System Technology Forecast (SV-9), the Technical Standards Profile (TV-1), and the Technical Standards Forecast (TV-2) to aid in these situations.

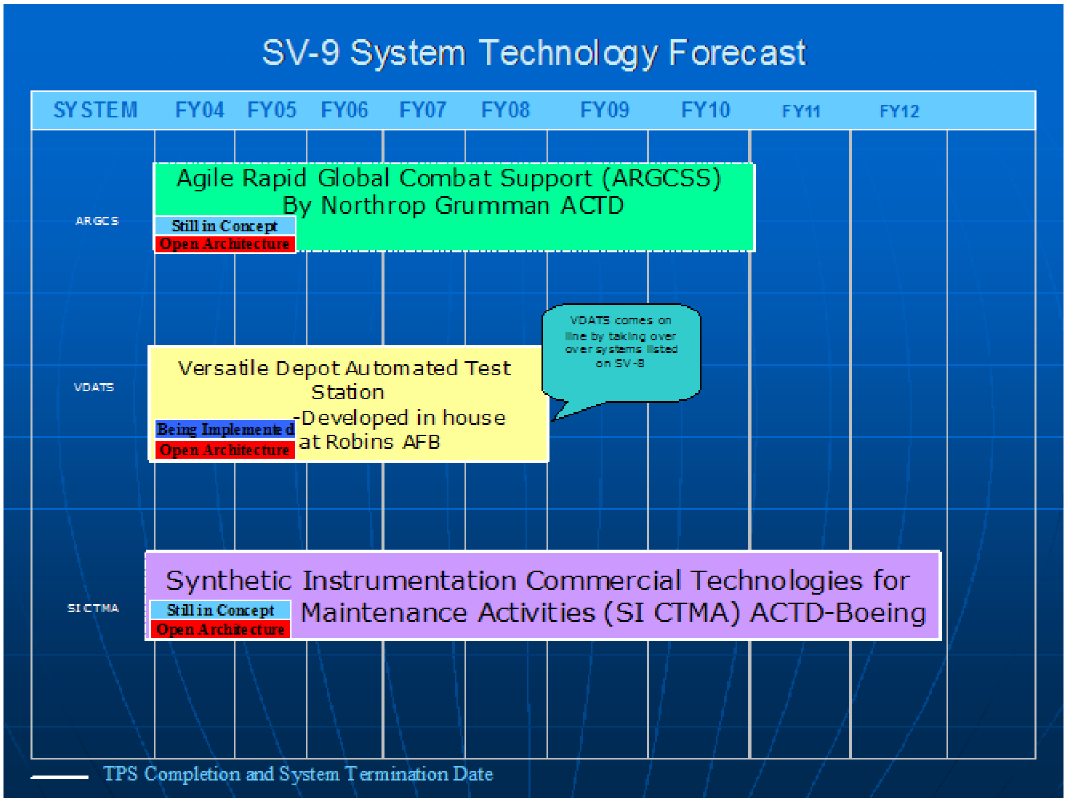

Figure 13. WR-ALC Systems Technology Forecast (SV-9)

The SV-9 in Figure 13 above shows that VDATS will be ready to be released to the depot in FY08 with all of the legacy functionality listed in the SV-8. Next, you will notice that there are the two Advance Concept Technology Developments (ACTD) listed. One is from Northup Grumman and the other is from Boeing; however, they both stemmed from the ARGCS concept of one tester that can service a family of different types of equipment in the joint environment. One of the main keys to making this concept reality is to know what standards apply to what equipment.

With technology changing at an ever fast pace it is important that the AF keep up with standards that affect its ATSs. Managing the standards that apply to systems now and tomorrow it will allow the AF to head off future potential shortfalls that the WarFighter could otherwise experience. The DoDAF TV-1 in Figure 14 below, assists in managing today's standards.

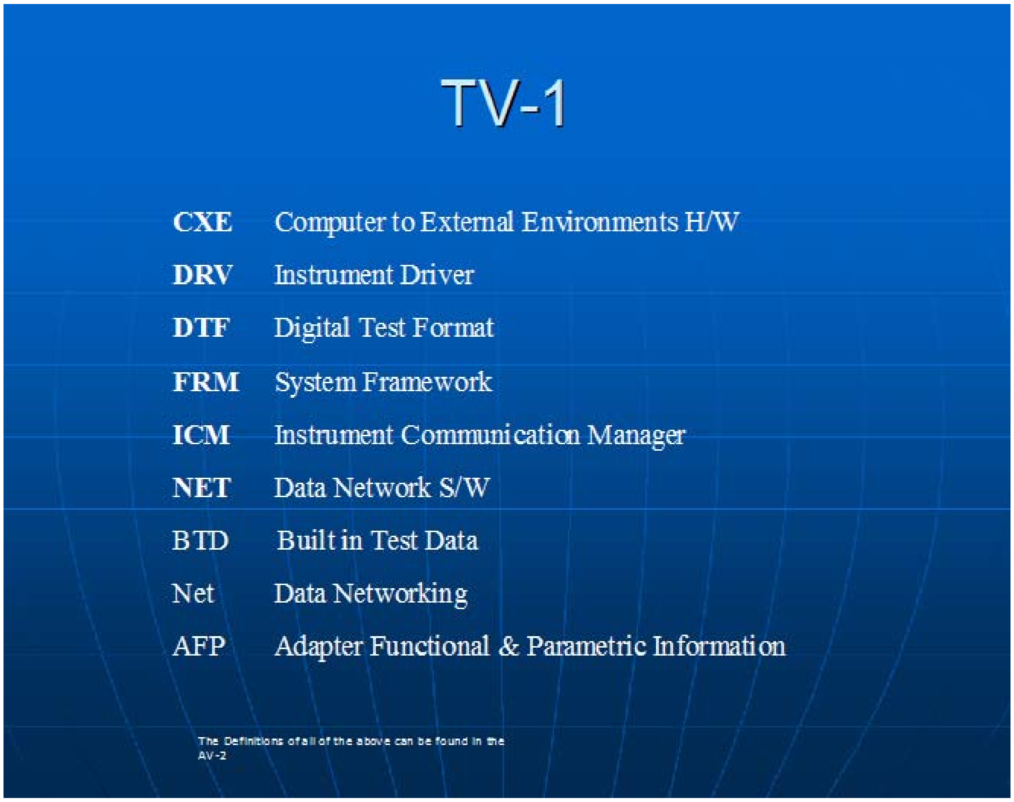

Figure 14. WR-ALC Technical Standards Profile (TV-1)

It is also very important to know what future standards will affect our systems. Our acquisition system has improved over the years; however, since it still takes many years to acquire a system thus making it even more important to know what standards the future holds. The document that the DoDAF defines for maintaining standards forecast is the TV-2 in Figure 15 below, it is a living document that is the focal point for future standards.

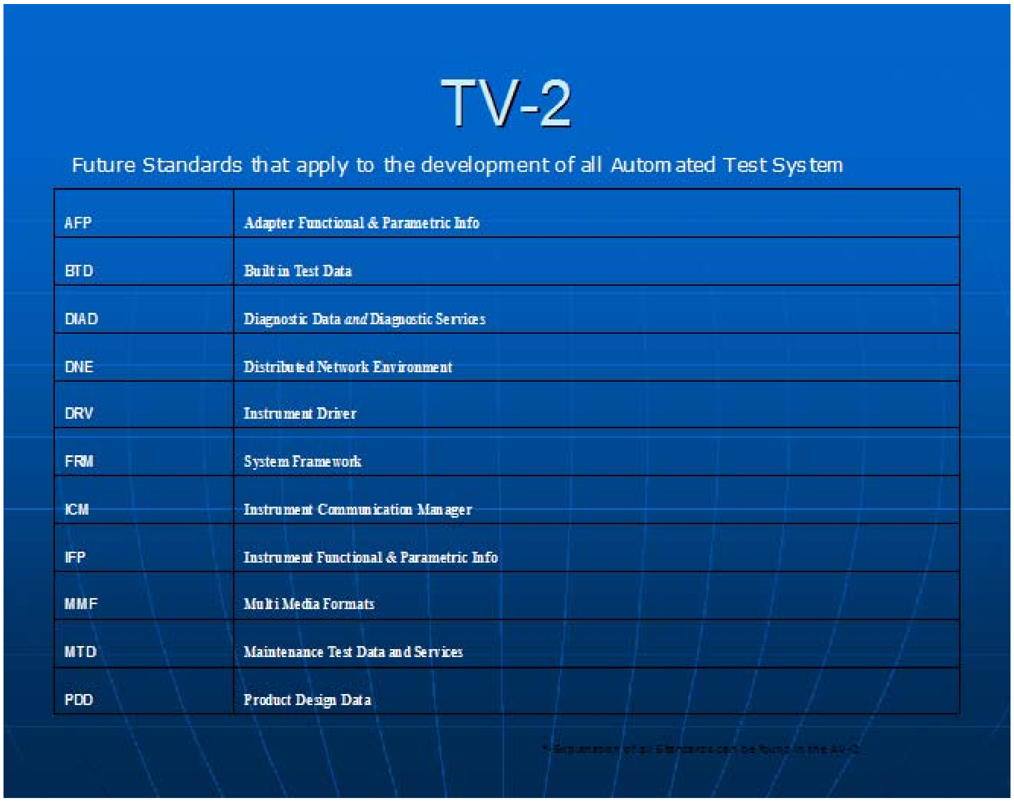

Figure 15. WR-ALC Technical Standards Forecast (TV-2)

C. THE ORGANIZATIONAL STRUCTURE ARCHITECTURE FOR ATS'S

The DoD realized there were problems with ATS proliferation in 1994 and since then the DoD has actively sought to reduce the number of unique testers and move towards commonality, consistent with the ARGCS concept. This policy led to the mandate that all AF System Program Offices (SPOs) go through the AF ATS Program Management Office (PMO) for approval of acquisition before buying ATSs. However, this process is rarely followed and there are currently no means to enforce policy. The current AF Operational Activity Model (OV-5) for procurement of ATSs is shown below in Figure 16 represented as a flow diagram.

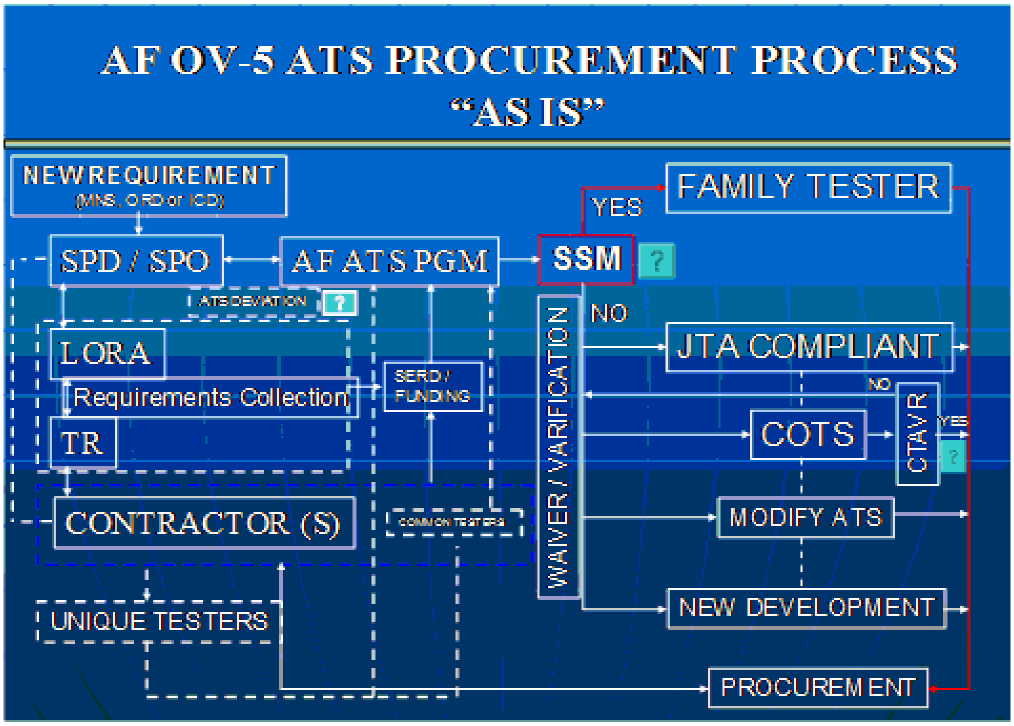

Figure 16. AF "As-Is" Operational Activity Model (OV-5) (From: ATS Program Management Office)

The process in Figure 16 depicts the currents process that the AF uses to purchase ATSs. To begin with in the acquisition phase (new requirement box), a new need for an ATS in the Initial Capabilities document (ICD). Next, that document is given to the SPO; the SPO in turn develops the Level of Repair Analysis (LORA) and Test Requirements -- generally in the form on a Supporting Equipment Requirements Document (SERD) prepared with contractor assistance. The SERD is then given to the ATS PO who then queries the SERD against the System Synthesis Model (SSM) to see if there is a common system that already exists to meet the requirements. If so, then the SPO must use that common tester. If there is a common tester that does not meet the TPS requirements, but does meet the hardware requirements, then the SPO should have the contractor develop Test Program Sets specifically for the existing tester. If no common tester matches the SERD in anyway, then the next step is to see if there is a COTS solution. If there is a COTS solution, then the SPO must prepare a Commercial Tester Acquisition Verification Request (CTAVR) waiver and the SPO may then purchase the COTS unit. If there is not a COTS solution then the next step is to try and modify an existing ATS, if this can be done then the SPO pays the contractor to make the modification; otherwise, the SPO is forced to undertake a new development.

The SPO should have a unique tester developed only as a last resort. However, because the ATS PMO does not have oversight of the ATS appropriated funds at the SPO, it allows the SPO to bypass all steps and purchase their own unique tester without notifying the ATS PMO. The current organizational structure for the flow is money is presented below in Figure 17 below in the form of a Legacy OV-4.

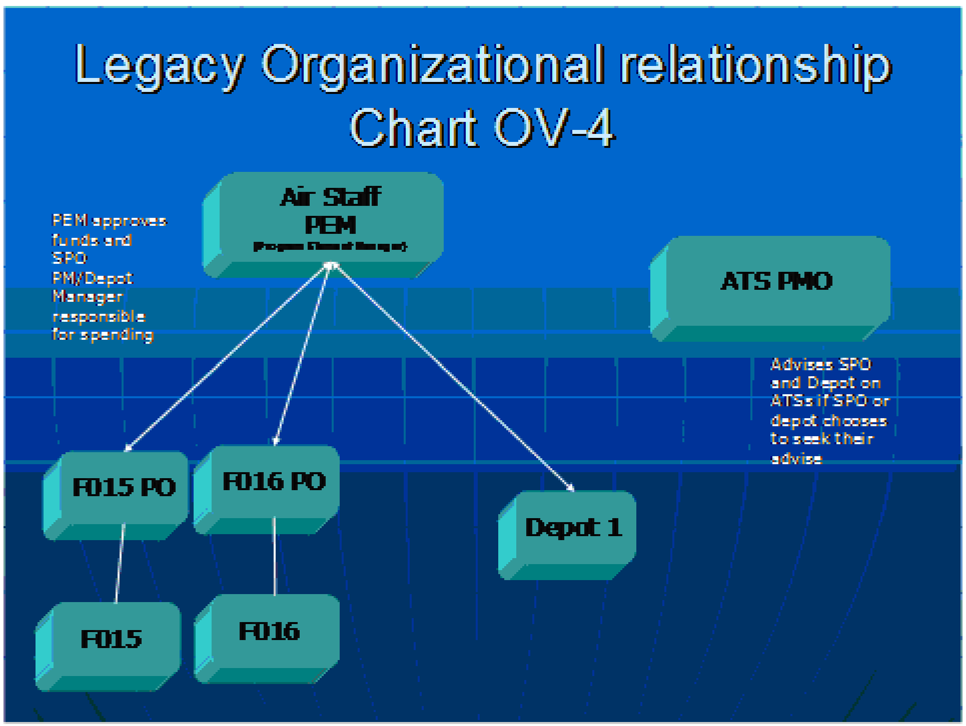

Figure 17. Legacy OV-4, the organizational structure for the flow of money to SPOs.

As is evident, the ATS PMO is organizationally disconnected from the flow of authority. This lack of ATS PMO authority has led to the AF having over 350 stovepipe legacy ATSs. The number 350 is what the ATS PO knows about at this time; however, it is likely there are more ATSs that have not yet been identified. As shown in Figure 17, there is no way to hold the SPO accountable to guidance from the ATS PO. If the SPO is denied the right to purchase the requested tester with one color of money then the SPO knows how to use other colors to ensure that the SPOs preferred tester is purchased without the ATS PO even knowing. The purposed way to mitigate the problems that the AF currently has with its ATS management policy is to add a Program Element Manager (PEM) at the Air Staff level to work with the various weapons systems PEMs for approval of ATS. Figure 18 depicts the new organizational structure in the form of a "To-Be" OV-4.

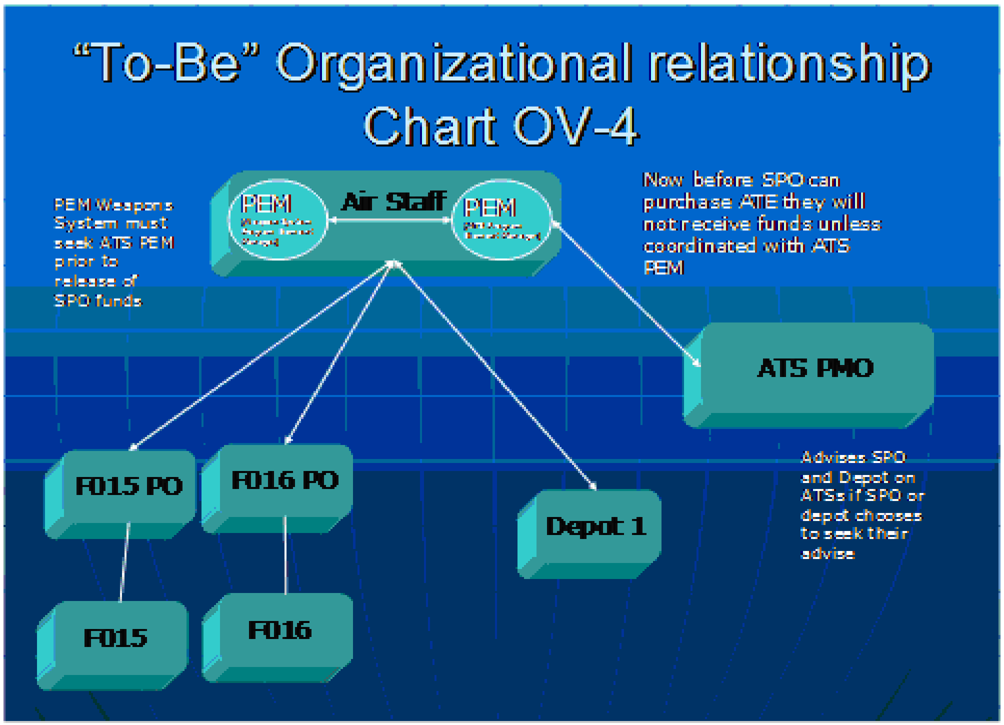

Figure 18. "To-Be" OV-4 (Organizational chart)

Figure 18 shows a way to correct the problem shown in Figure 17. When SPOs have a new requirement for an ATS, then the weapons system PEM must pass this requirement to the ATS PEM; the ATS PEM would then work with the ATS PO to map those requirements to a common tester or grant appropriate waivers. Figure 19 below represents the future procurement process which would ensure that all new ATSs procurement would flow through the ATS PMO for review.

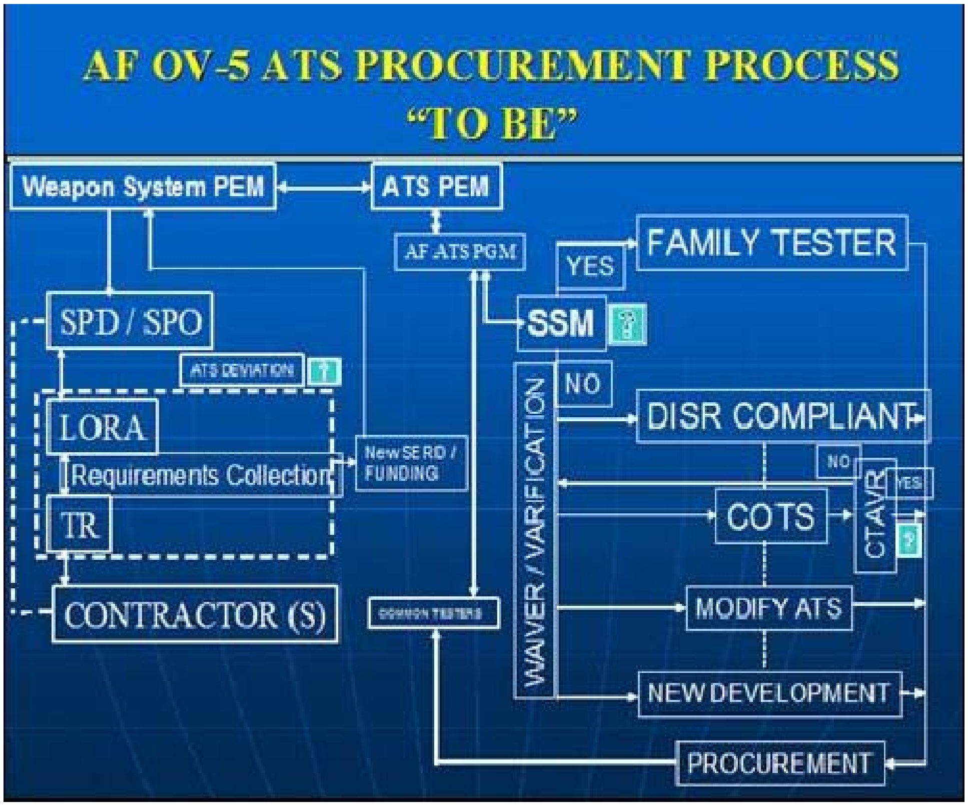

Figure 19. "To Be" ATS Procurement Process, with ATS PEM Involvement. (After: Program Management Office)

It is very important to keep the ATS PMO notified of all new ATS procurements. ATS management was not a concern in the past thus led to the vast array of ATS in inventory today; however, with the cost of ATSs running the DOD "over $50 Billion in acquisition and support from 1980 through 1992," (GAO, 2003, p. 8).it is now a priority in the DoD and must be embraced by the senior leadership in the AF.

D. HOW EA SUCCESS AND BUSINESS VALUE IS MEASURED

The success of EA methods can be measured in many ways ranging from customer surveys, savings from various projects, and how well the EA gets organizations working on the same "playing field". It is very important in today's business environment to ensure that the organization is collectively working towards the same strategic goal, and the EA above will do just that. Management must also be able to look at the architecture and see how the organization functions, what systems support those functions, and how a new systems might affect that organization. The EA prepared for this project revealed the following:

1. The mission of the depot and a subset of systems that support it.
2. There was duplication amongst legacy ATSs (shown in the SV-5)
3. VDATS fits into the ARGCS concept thus making the depot compliant with the DoD mandate to move toward a family of testers
4. Reduction of the logistics footprint (OV-2 shows VDATS servicing multiple legacy equipment)
5. VDATS is interoperable by being able to test multiple types of equipment is the OV-2, SV-8, OV-5, SV-5, and OV-1.
6. There is an organizational flaw in the way that the AF has currently structured its ATS Program Management Office (PMO) and Procurement Process.
    a. The “As-Is” & ”To-Be” OV-4 show this for the ATS PMO
    b. The “As-Is” &”To-Be” OV-5 show this for the Procurement Process.

The business value the EA has streamed lined the depots established baseline of what it currently does. It shows how future ATSs could affect the depot mission and current systems. The EA also established the “As-Is” & “To-Be” Business Behavior of the Procurement Process. It is this “As-Is” baseline that helps AF leadership understands where their problems lie in the management of the ATS Procurement Process. At the same time, the EA offers a way to fix the process by defining a path for the future. The EAs ability to do these things in a clear presentation will allow transformation and alignment with DoD architecture mandates.

E. LIMITATIONS OF THE WR-ALC EA AND NEXT STEPS

While the WR-ALC EA did meet its intended purpose, one of its limitations is that it is very high level architecture. The next steps in completing the EA would be to show the following:

1. All organizations that the depot interfaces with using detailed need lines.
2. Map out legacy system functionality to operational node connectivity to see what organizations are affected by what testers. This would allow the depot to see where VDATS could further be used.
3. Create a repository so that all organizations could understand the depot architecture.

In order to ensure that the depot enterprise moves forward it is critical that the architecture be used and the above actions completed. EA is not meant to be used just for funding; therefore, it must be maintained and used as a tool to aide in management decisions to move the enterprise forward in order to meet strategic objectives.

F. CONCLUSION

In conclusion, the WR-ALC EA has been presented in a value added fashion to show:

1. What the depot mission is.
2. Subset of systems that support that mission.
3. Problem areas that constrain the management and procurement of ATSs.
4. Problems with the legacy ATSs.

The problems and solutions with the management and procurement of ATSs were explained in Figures 16-19. If the solutions are implemented correctly this could mitigate the current ATS problems and prevent it from happening again. With that said, the problems that the depot is facing with ATSs must be resolved. The VDATS is a prime solution that will resolve the depot problems and also implement DoD policy using the ARGCS concept of a family of ATSs. The VDATS fulfills the ARGCS requirements in the following ways:

1. Reduces the logistics footprint, i.e. scalable
2. Able to take on the role of various legacy systems reducing ATSs, i.e. interoperable
3. Uses open architecture standards thus ultimately allowing each VDATS to be a back up of itself, i.e. common framework and agility.
5. Implementation of COTS resources where possible.
6. Open architecture thus allowing repair of electronic components by all vendors.

The VDATS system was designed specifically to test all type of electronics that could be used in the development of avionics. It has been shown using the various architecture views how the VDATS will reduce legacy systems and impact the various organizations. Thus far the VDATS has performed above and beyond initial expectations. It is believed that VDATS will change the way that the AF approaches any new requirements concerning avionics and testing.

IV. ECONOMIC ANALYSIS

A. INTRODUCTION

The Warner Robins-Air Logistics Center (WR-ALC) Depot completed an Economic Analysis titled “Common Testers and Software Translation Tool (CTST), Phase III. (2005).” to see if it was appropriate to begin up grading their Automated Test Equipment in FY09 or FY10. They developed two alternatives using constant FY05 (base year) dollars inflated to the FY09 program year dollars that have different time periods and implementations, but with the same end results. Alternative A would begin in FY10 and take three years to implement, while alternative B would begin in FY09 and take 2 years to implement. The following Extended Economic Analysis is an extension of the WR-ALC economic analysis. The time period between FY09 and FY12 is critical because those are the years in which there are significant differences between the two alternatives. This analysis and the one by WR-ALC used the assumptions stated in Appendix A. However, This section will take the WR-ALC economic analysis a step further to address the following:

1. Operating Cost Reduction Worksheet
2. One-time (Non-recurring) Cost Worksheet
3. On-going (Recurring) Cost Worksheet
4. Total Savings
5. Internal Rate of Return.

One of the main findings in this Analysis, Table 1 and Table 2, is that comparison of alternatives hinges upon the first four years of the projects. This is because all cost associated with both alternatives are the same after the first four years. The reason that the costs are not the same in the first four years is due to different program schedules.

Fiscal Year		Maintenance Costs (FY09$)		Electrical Power Consumption (FY09$)		Calibration (FY09$)		Total O&M Costs (FY09$)
2009	$	2,388,362	$	124,195	$	286,603	$	2,799,160
2010	$	2,866,034	$	155,244	$	334,371	$	3,355,648
2011	$	2,866,034	$	155,244	$	334,371	$	3,355,648
2012	$	2,866,034	$	155,244	$	334,371	$	3,355,648
2013	$	477,672	$	31,049	$	47,767	$	556,488
2014	$	477,672	$	31,049	$	47,767	$	556,488
2015	$	477,672	$	31,049	$	47,767	$	556,488
2016	$	477,672	$	31,049	$	47,767	$	556,488
2017	$	477,672	$	31,049	$	47,767	$	556,488
2018	$	477,672	$	31,049	$	47,767	$	556,488
Total	$	13,852,497	$	776,218	$	1,576,319	$	16,205,033

Table 1. Recurring Cost for Alternative A FY09 dollars (From: CTST Phase III)

Fiscal Year	Maintenance Costs (FY09$)	Electrical Power Consumption (FY09$)	Calibration (FY09$)	Total O&M Costs (FY09$)
2009	$2,866,034	$155,244	$334,371	$3,355,648
2010	$2,866,034	$155,244	$334,371	$3,355,648
2011	$477,672	$31,049	$47,767	$556,488
2012	$477,672	$31,049	$47,767	$556,488
2013	$477,672	$31,049	$47,767	$556,488
2014	$477,672	$31,049	$47,767	$556,488
2015	$477,672	$31,049	$47,767	$556,488
2016	$477,672	$31,049	$47,767	$556,488
2017	$477,672	$31,049	$47,767	$556,488
2018	$477,672	$31,049	$47,767	$556,488
Total	$9,553,446	$558,877	$1,050,879	$11,163,202

Table 2. Recurring Cost for Alternative B FY09 dollars (From: CTST Phase III)

One of the most important components of system life cycle cost is the recurring costs to operate and maintain that system. Table 3 below considers the difference between the recurring cost of Alternatives A and B for Maintenance Cost, Electrical Power, and Calibration. In FY09, there are negative numbers due to paying for the implementation of alternative B while also paying for sustainment of forty four legacy systems. In FY10 both alternatives are the same because Alternative A implements the new system and pays for sustainment of forty legacy systems just like alternative B, thus the zero value. The real savings start in FY11 and continue through FY12. The main savings in FY11 and FY12 occur with Alternative B because Alternative A takes longer to implement and must pay for continuing sustainment of the legacy systems. Past FY12 Alternatives A & B have the same values. Table 3 below reveals that Alternative B lowers operating cost and saves $5M in just four years.

	Operating Cost Reduction Worksheet				
	2009	2010	2011	2012	Total
Maintenance Cost Savings	-477672	0	2388362	2388362	**4299052**
Electrical Power Savings	-31049	0	124195	124195	**217341**
Calibration Savings	-47768	0	286604	286604	**525440**
Totals	**-556489**	**0**	**2799161**	**2799161**	**5041833**

Table 3. Operating Cost reduction Worksheet for implementing alternative B FY09 dollars (After: CTST Phase III)

The worksheet, Table 4 below, identifies the non-recurring cost of both alternatives. These non-recurring costs are made up of labor and equipment. The labor and equipment cost shown are associated with the one time investment cost for transfer test program sets to the new Automated Test System (ATS) and the actual twenty two pieces of ATS/Interface Test Adapter (ITA) equipment. Table 4 shows that Alternative B is $8.5M (25%) cheaper.

One-time (Non-recurring) Costs Worksheet

Initial Investment	**Labor**	**Equipment**	**Total**
Alt A	18564083	15723400	**34287483**
Alt B	9996379	15723400	**25719779**

Table 4. Economic Benefits of Non-recurring cost of New system FY09 dollars (After: CTST Phase III)

Next, it is important to consider the recurring cost for both alternatives for the four years in which they are different (FY09-12). Table 5 shows that alternative B is 200k cheaper.

	Alternative B On-going (Recurring) Costs Worksheet				
	2009	2010	2011	2012	Total
Maintenance Cost	2866034	2866034	477672	477672	6687412
Electrical Power	155244	155244	31049	31049	372586
Calibration	334371	334371	47767	47767	764276
Totals	3355649	3355649	556488	556488	7059998
	Alternative A On-going (Recurring) Costs Worksheet				
	2009	2010	2011	2012	Total
Maintenance Cost	2388362	2866034	477672	477672	6209740
Electrical Power	124195	155244	31049	31049	341537
Calibration	286603	334371	47767	47767	716508
Totals	2799160	3355649	556488	556488	7267785

Table 5. Recurring cost for both alternatives FY09 dollars (After: CTST Phase III)

In order to completely understand the benefits of Alternative B we must summarize the various savings. It is extremely important to remember that both alternatives end up with the same solution; however, they are implemented over different time frames – which drive the savings associated with Alternative B. The total savings can be seen in Table 6 below, by taking the total from the cost reduction and adding it to the difference between the non-recurring cost and the recurring cost. The end result is that alternative B is almost $14M cheaper than alternative A during the four year analysis period.

Cost reduction	5041833
Difference in Non-recurring	8567704
Difference in recurring	207787
Total	13817324

Table 6. Total Savings provided by alternative B FY09 dollars (After: CTST Phase III)

Finally, we must look at the Internal Rate of Return (IRR) for both alternatives to find out which is the best value. In order to compute the IRR you must remember that the only difference between alternative A and B are exactly the first four years. Table 7 below shows that the IRR is 42% which makes option B the best solution for the problem of upgrading the ATSs. If you just compare FY09 and FY10 the IRR is still 31% which again makes alternative B the best solution.

	Differences Between Two Alternatives By Year				
Recurring	-0.56	0	2.4	2.4	
Non-recurring	-25.72	34.3	0	0	
Total	-26.28	34.3	2.4	2.4	
IRR(FY09-FY12)	41.53%				
IRR(FY09-FY10)	30.52%				

Table 7. IRR of Alternative B (relative to A, $M). (After: CTST Phase III)

In conclusion, when looking at the problem that the WR-ALC Depot is facing, this extension economic analysis concludes that Alternative B is the better solution. The Air Force will save an estimated $5M over these four years in operating cost, $200k in recurring cost, and almost $8.5M in initial funding over alternative A. The total savings alternative B offers over alternative A is $14M over four years. And, these results are captured in the IRR of 42% for Alternative B (vs. A).

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V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSION

In summary, the problems that the DoD is having with ATSs is currently being mitigated through the ARGCS concept requirements. The WR-ALC is trying to achieve ARGCS capabilities AF through the use of VDATS. The WR-ALC Enterprise Architecture (EA) offered here reveals a duplication of functionality within ATSs in the AF, organizational flaws in the way that ATSs are managed, and current ATS procurement processes that could be improved. It also presented solutions to each of these problems through the use of VDATS to reduce duplication of functionality, and associated change in practices to manage the new ATS concepts, as well as restructuring procurement processes to manage ATS purchasing to avoid costly duplications. Finally, the best method to address the current ATS problem is through a structured approach that features careful attention to enterprise architecture and the use of BCAs (and EAs).

Next, the Economic Analysis (EA) has shown that VDATS has an outstanding return on investment and thus should be implemented elsewhere in the AF. The total saving that the WR-ALC depot alone will see in just four years will be $14M with and IRR of 42%. The AF has two other depots not yet analyzed which face the same problems. The numbers of ATSs at these depots are not readily available at this time, which reveals difficulties in current Air Force ATS management practices. Analyses using the methods employed here for those two depots to determine what savings may be found using ARGCS concepts (such as VDATS) should be accomplished by a future study.

In short, this study strongly indicates that the best approach to improving ATS management is to manage the Enterprise through using Enterprise architecture and quantitative analysis; establish an ATS PEM at the Air Staff level (Figure 18); and restructure the ATS Procurement Process in accordance (Figure 19), and finally implement the VDATS in the WR-ALC.

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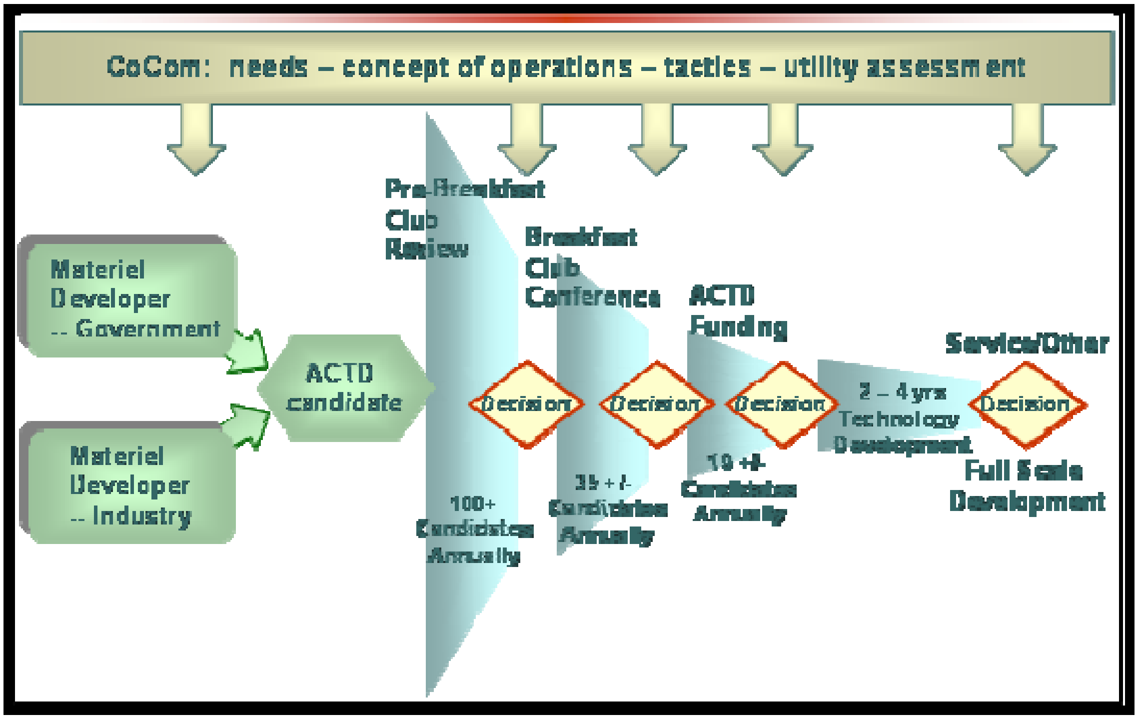
APPENDIX A. A METHODOLOGICAL APPROACH FOR CONDUCTING A BUSINESS CASE ANALYSIS FOR THE ADVANCED TECHNOLOGY ORDNANCE SURVEILLANCE ADVANCED CONCEPT TECHNOLOGY DEMONSTRATION BY KRATZER

A. KRATZER STUDY

The Department of Defense (DoD) has seen the need to change the way that it acquires its new technologies. The Kratzer (2005) feels that

> budget constraints, significant changes in threats, and an accelerated pace of technology development have challenged the ability of the Component Commanders (COCOMs) to adequately respond rapidly to the evolving military needs. Part of the Department of Defense response to the challenges has been to initiate the Advanced Concept Technology Demonstration program in early 1994 to get new technologies into the hands of the WarFighter as quickly as possible.
>
> The ACTD program is designed to assist the DoD acquisition process adapt to today's economic and threat environments. ACTDs identify significant military needs and match them to mature technologies or technology demonstration programs which are maturing key technologies in order to solve important military needs (see Figure 2). These technologies are then combined and integrated into a complete military capability to provide decision makers an opportunity to understand fully the operational potential offered by a proposed new military capability before making an acquisition or sustainment decision. This goal is met by developing fieldable prototypes of the proposed capability and providing those prototypes to the WarFighter for evaluation of that capability. The WarFighter evaluates the capability in real military exercises and at a scale sufficient to assess fully military utility. During the ACTD, the WarFighter also evolves the broad statement of need, which existed at the start of the ACTD, into a definitive set of operational requirements that can support a follow-on acquisition. At the completion of the ACTD, the prototypes used in the evaluation process are left with the WarFighter to provide an interim capability or, in some cases, to fulfill the total, current need.



ACTD Development Process (From ACTD 2004).

In a February 24, 2005 article in Inside the Pentagon, titled "DOD Plans New Acquisition Executive Post To Champion Joint Programs," plans were announced on establishing the policies for ACTDs and JCTDs.

The Pentagon plans to establish a new acquisition executive to champion technologies and concepts designed for joint operations, according to defense officials and documents.

The creation of the new position is part of a wider effort to overhaul the advanced concept technology demonstration program -- the Pentagon's marquee project for rapidly fielding new technologies -- into another effort called the joint capability technology demonstration program.

The goal is to expedite deliveries of new technologies to soldiers, sailors, airmen and Marines by putting in place new funding mechanisms and organizations to make sure new, proven weapons and combat technologies are designed for use by more than one service and not orphaned by individual services at budget time.

Beginning Oct. 1, the Pentagon plans to have in place the new acquisition executive to ensure "cradle to grave" funding and advocacy for promising technologies that do not have clear champions in the Army, Navy, Air

Force or Marines. This new post would be equal in rank to the service acquisition executives, according to Defense Department officials.

To facilitate this undertaking the Office of the Secretary of Defense has shifted $40 million in its fiscal year 2006 budget proposal from the ACTD budget line to initiate JCTD programs.

"This is just seed money," said Mark Peterson, head of program resources and integration for the deputy under secretary of defense for advanced systems and concepts, in a Feb. 22 interview. "We expect in next year's budget that this might change.

"So do senior Pentagon officials. In a late December budget decision, Deputy Defense Secretary Paul Wolfowitz directed the under secretary of defense for acquisition, technology and logistics and the chairman of the Joint Chiefs of Staff to establish an improved process to transition promising ACTDs to acquisition programs and bring forward a new spending proposal this summer for consideration in the FY-07 budget.

Pentagon officials say the joint capability technology demonstration effort is designed to deliver the improved transition process Wolfowitz seeks. It is the brainchild of Sue Payton, the deputy under secretary of defense for advanced systems and concepts, who has worked for the last 18 months to improve the ACTD process and put in place what she calls a new business model for rapidly fielding new technologies desired by combatant commanders.

Beginning in 1994, the ACTD program established an alternate route to quickly put new technologies in the hands of WarFighter. The program takes new but relatively mature technology and offers the services the opportunity to assess prototypes in a military environment. Targeted to address pressing requirements, ACTDs typically spend three to four years in development, after which a handful of prototypes are delivered to military units. They spend as many as two more years evaluating the technology for operational usefulness.

This four- to six-year cycle is faster than the traditional acquisition cycle, which can take between 10 and 15 years from the concept stage to fielding.

In some cases, technologies developed through ACTDs are used primarily by a single service. At the end of the demonstration, the service can buy more of the capability or walk away from the project. Many ACTDs, however, are designed expressly for commanders who are seeking to improve the coordination and operations of service-specific technologies that weren't designed to work together. In some cases, the objective is to acquire a technology none of the services provides.

Once an ACTD is complete, the four-star combatant commanders who sponsor them must depend on one of the services to acquire the technology and fund its operational use, although U.S. Special Operations Command has unique acquisition authority and is exempt from this rule. The services, however, do not always rank ACTDs desired by combatant commanders high in their procurement portfolios.

"Military services and defense agencies have been reluctant to fund acquisition of ACTD-proven technologies, especially those focusing on joint requirements, because of competing priorities," the Government Accountability Office said in a December 2002 report.

The Pentagon's FY-06 budget request includes $40 million to kick start a number of proposals aimed at correcting key difficulties that have surfaced in guiding new technologies from government and commercial laboratories to troops and into the Pentagon's acquisition and operations accounts.

These funds will be spread across four new program elements to fund JCTDs as well as a pilot program to establish a new defense acquisition executive.

This new position would share rank with the service acquisition executives and be the primary advocate in the budget process for joint capabilities that do not have a natural place in any of the service accounts.

Key to the new approach is a change in how projects are funded. In order to remain as responsive to the current needs of combatant commanders, the Pentagon keeps ACTDs out of its planning, programming and budget execution cycle, which involves a two-year delay between requesting and receiving funds.

"So every time an ACTD starts, if a service has not already been planning, you have to break [another] program" to find the money for the new project, said Peterson. The net effect: "We create an instant unfunded requirement," he said.

Under the JCTD approach, the Office of the Secretary of Defense will provide more funds at the beginning of a project, boosting its start-up contribution from 30 percent to at least 50 percent in order to reduce the pressure on the services to find money for the project outside of the budget cycle.

The JCTD process will set shorter time lines for demonstrating new concepts or technologies.

"We would like to make that quicker by at least a year," said Peterson.

The JCTD strategy will require a final demonstration in two to three years, faster than the three-year to four-year goals for most ACTDs. In the first year, JCTD officials will be required to deliver a preliminary capability.

After that, they must be 50 percent complete by the end of the second year and wrap up in the third year. Payton also wants 80 percent of JCTDs to transition at least half of their products into a permanent place in the Pentagon's budget.

The following are some examples of FY06 ACTDs and JCTDs. These ACTD/JCTDs have the potential to support COCOM missions, whether or not they evolve into full-fledged programs of record. For a full list of ACTDs and JCTDs, refer to Appendix A and the following web link.

http://www.acq.osd.mil/actd/descript.htm

Agile Global Combat Support (ARGCS)

Comprehensive Maritime Awareness (CMA) JCTD

CHAMPION (Counter Intelligence-Human Intelligence Advanced

Modernization Program/Intelligence Operations Now) JCTD

Extended Space Sensors Architecture (ESSA)

Joint Modular Intermodal Distribution System (JMIDS) JCTD

Large Data JCTD

Multi-service Advanced Sensors to Counter Obscured Targets (MASCOT)

Joint Enable Theater Access (JETA)

Event Management Framework (EMF)

Node Management And Deployable Depot (NOMADD)

Small UAV

At the conclusion of the ACTD operational demonstration, there are three possible outcomes.

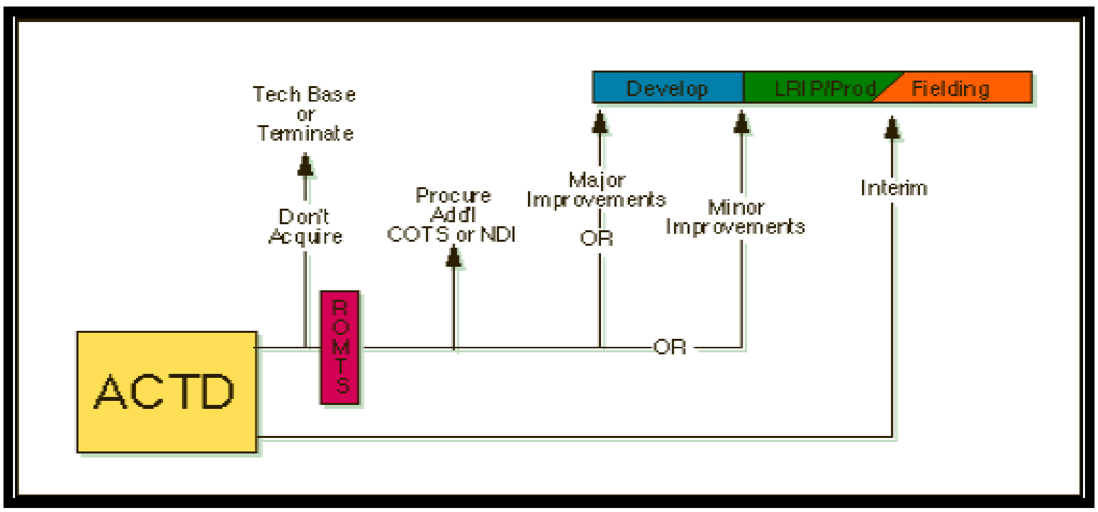
First, recommend acquisition of the technology.

Second, if the capability or system does not demonstrate military utility, the project is terminated or returned to the technology base.

Third, the Warfighter's need is fully satisfied by the fielded prototype capability that remained onboard and there is no need to acquire additional units.

ACTD/JCTD Transition Process

Figure 2 below outlines possible paths which the ACTD in review might follow as it transitions to a program of record.



Alternatives Following Completion of ACTD (From Ref. ACTD 2004).

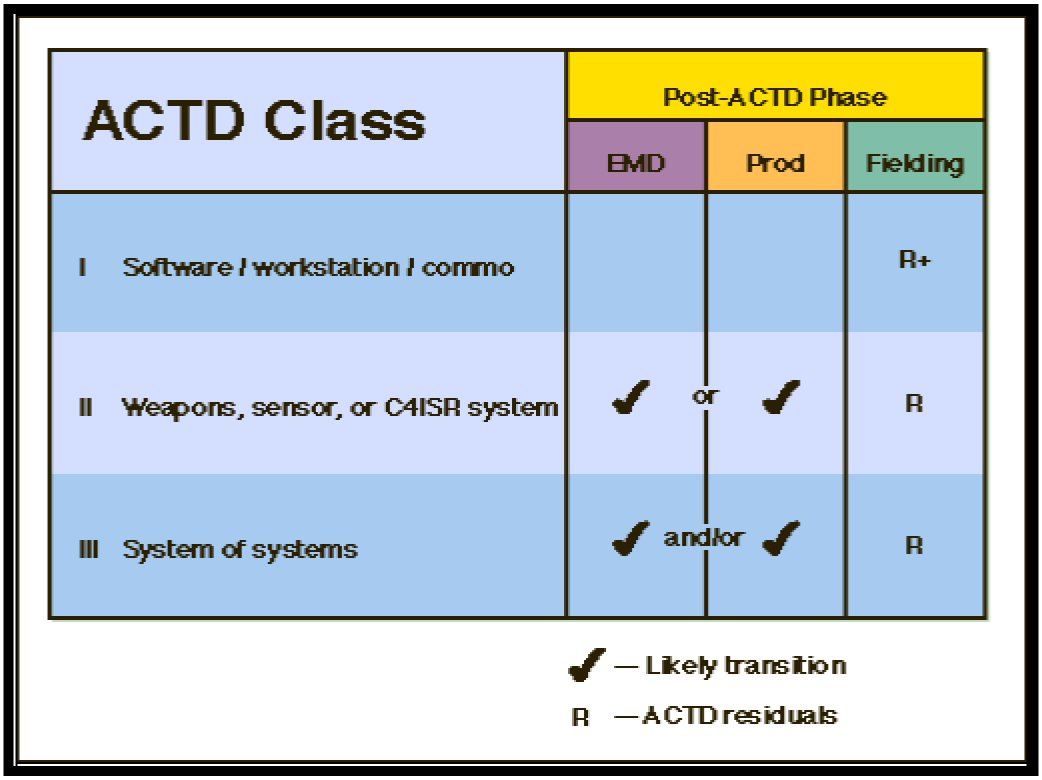
Transition to the formal Defense acquisition process will be necessary when development or production is required. The acquisition category will depend on both the number and cost of systems required to meet the military need. The next step is to determine at what point does the ACTD enters the acquisition process. If significantly more development of the technology is required, the system might enter into the development portion of the Engineering and Manufacturing Development (EMD) phase. On the other hand, if the capability of the ACTD is sufficient and needed promptly, entering into the Low-Rate Initial Production (LRIP) portion of EMD is an option.

There are three generic classes of ACTDs that present significantly different transition challenges:

a. Class I ACTD. These are typically informational systems with special purpose software operating on commercial workstations. They frequently are required in small quantities, and that requirement can be satisfied without further development or production using the residual ACTD system (residual ACTD systems are the systems used during the ACTD that are left behind with the WarFighter to meet his military need) or a few additional systems [ACTD 2004].

b. Class II ACTDs. These are weapon or sensor systems similar in concept to systems that are acquired through the formal acquisition process. In some cases a Class II ACTD will be planned ahead of time to transition into LRIP following ACTD, but at other times it is appropriate to plan for additional development following the ACTD [ACTD 2004].

c. Class III ACTDs. These ACTDs are best described as “systems of systems.” This means that an individual element within the overall system of a Class III ACTD may be a fielded system, a system already in acquisition, or a system emerging from the technology base. The overall ACTD may involve multiple Program Executive Officers (PEO), and perhaps multiple Military Departments. The challenge here is to integrate and coordinate the individual transitions to achieve the capability presented in the ACTD [ACTD 2004].



ACTD Class	Post-ACTD Phase		
	EMD	Prod	Fielding
I Software / workstation / commo			R+
II Weapons, sensor, or C4ISR system	✓ or	✓	R
III System of systems	✓ and/or	✓	R

✓ — Likely transition
R — ACTD residuals

Classes of ACTDs (From Ref. ACTD 2004) (p15-22).

APPENDIX B. ASSUMPTIONS FROM WR-ALC ECONOMIC ANALYSIS

A. ASSUMPTIONS

a. Program Year: FY 2009. (Source: Walter Blount, Electronic Engineer, 402 EMXG/MXVOPE, DSN 468-5431).

b. The analysis period is 10 years. (Source: Walter Blount, Electronic Engineer, 402 EMXG/MXVOPE, DSN 468-5431).

c. All costs will be expressed in FY05 constant (base year) dollars, unless stated otherwise. (Source: Walter Blount, Electronic Engineer, 402 EMXG/MXVOPE, DSN 468-5431).

d. USAF Raw Inflation Indices are used to adjust all historical cost to FY09 dollars. (Source: USAF Raw Inflation Indices issued by SAF/FMC on 3 Feb 05)

e. All costs are discounted using a “middle-of-year” discount convention. The real discount rate is 2.5 percent (for 7 thru 10 years analysis period). (Source: SAF/FMCE, Discount Rates for Economic Analysis, Revised 9 Feb 05)

f. The number of personnel will remain the same. (Source: Walter Blount, Electronic Engineer, 402 EMXG/MXVOPE, DSN 468-5431).

g. Terminal value will be negligible for all alternatives. (Source: Walter Blount, Electronic Engineer, 402 EMXG/MXVOPE, DSN 468-5431).

h. There are no Research and Development costs associated with either alternative. (Source: Walter Blount, Electronic Engineer, 402 EMXG/MXVOPE, DSN 468-5431).

i. The investment in the software translation tool for Alternative B is estimated to cost $1,000,000 (FY05$) (Source: Walter Blount, Electronic Engineer, 402 EMXG/MXVOPE, DSN 468-5431).

j. New Equipment Re-host Costs:

Current Re-host Procedure: The labor cost to re-host a Test Program Set (TPS) is estimated at $100,000 (FY05$) per set. A total of 171 TPSs will be re-hosted beginning in FY 2010. (Source: Walter Blount, Electronic Engineer, 402 EMXG/MXVOPE, DSN 468-5431).

New Re-host Procedure: Based on savings expected by use of the new software translation tool, the cost of the new re-host procedure is estimated at $48,000 (FY05$) for each TPS. (Source: Bob Pennington, 402 SMXG/MXDEG, Inc DSN 468-1307)

k. The purchase price of an Automatic Test Equipment (ATE) station is $700,000 (FY08$). The purchase of 22 ATE stations is scheduled for FY 2010. (Source: Larry Smith, 402 EMXG/MXVOPE, DSN 468-5456).

B. MAINTENANCE COSTS PER YEAR

Current Equipment: The test stations in MAI are maintained by either contract support or organic support. For this analysis, an average of the two methods was used. MAIPE is responsible for handling test station contracts for MAIE. The average contract cost per test station is $40,000 per year. Some contracts are more expensive and some are less expensive. (Source: Larry Smith, 402 EMXG/MXVOPE, 468-5456) The estimated average downtime per test station is 30% or 600 hrs per year, which equates to an organic maintenance cost of $60,000 per year. Considering both contract and organic repair, the annual average maintenance cost is $50,000 per test station. The maintenance cost for the old test stations is $2,200,000 per year.

New Equipment: Based on the speed and new technology of the new test stations, 1 new test station can replace 2 old test stations. For this project, 22 new test stations, will replace 44 old test stations. The maintenance cost on a new test station is $20,000 per year based on a current contract. Therefore, the maintenance cost of the 22 new test stations is $440,000 per year. (Source: Walter Blount, Electronic Engineer, 402 EMXG/MXVOPE, DSN 468-5431).

a. Electrical Power Consumption:

Current Equipment: The annual electrical power cost for a Digital Test Station DTS-70 is $2,600. (Source: Jim Bond, MAIPF, DSN 468-9622) The electrical power cost for the old test stations is $114,400 per year.

New Equipment: The new test stations are smaller and require approximately half the power of the old test stations, which equates to $1,300 per year per test station. Based on the speed and new technology of the new test stations, 1 new test station can replace 2 old test stations. The purchase of 22 new test stations will replace 44 old test stations. The cost for the new test stations is estimated at $28,600 per year. (Source: Walter Blount, Electronic Engineer, 402 EMXG/MXVOPE, DSN 468-5431).

b. Calibration:

Current Equipment: Calibration for an old test station cost approximately $3,000 per 6-month cycle or $6,000 per year. (Source: Tony Hamlett, 402 EMXG/MXVOPE, DSN 468-2514) The calibration cost for the old test stations is $264,000 per year.

New Equipment: Calibration of a new test station should only cost around $2,000 per year. Based on the speed and new technology of the new test stations, 1 new test station can replace 2 old test stations. The purchase of 22 new test stations will replace 44 old test stations. The cost for the new test stations is estimated at $44,000 per year. (Source: Walter Blount, Electronic Engineer, 402 EMXG/MXVOPE, DSN 468-5431).

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